The Mining Journal

Established 1835 — Railway & Commercial Gazette

Vol. CCXLIII No. ~~6126~~ 6216 — LONDON, OCTOBER 8, 1954 — PRICE 8d.

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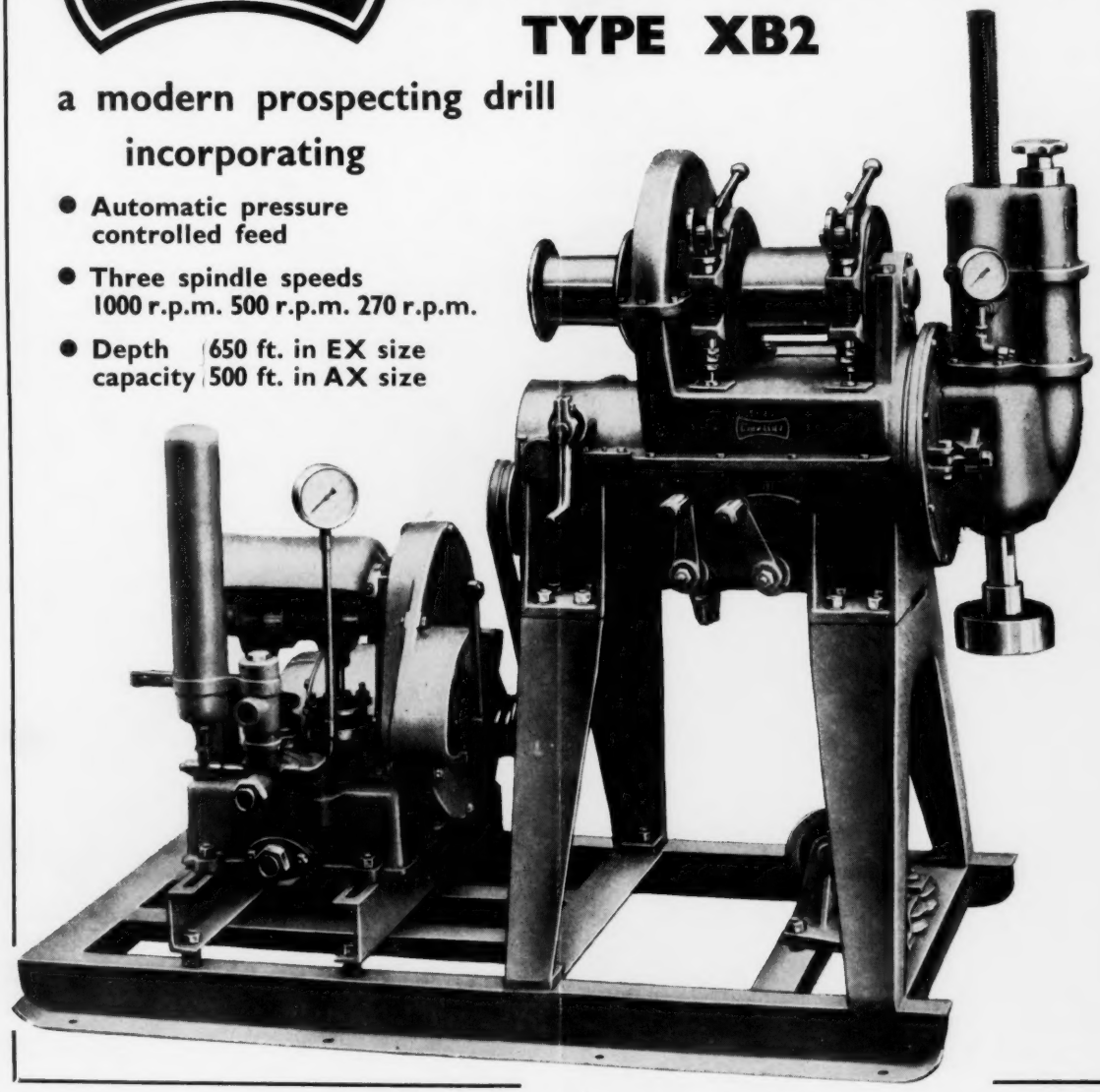

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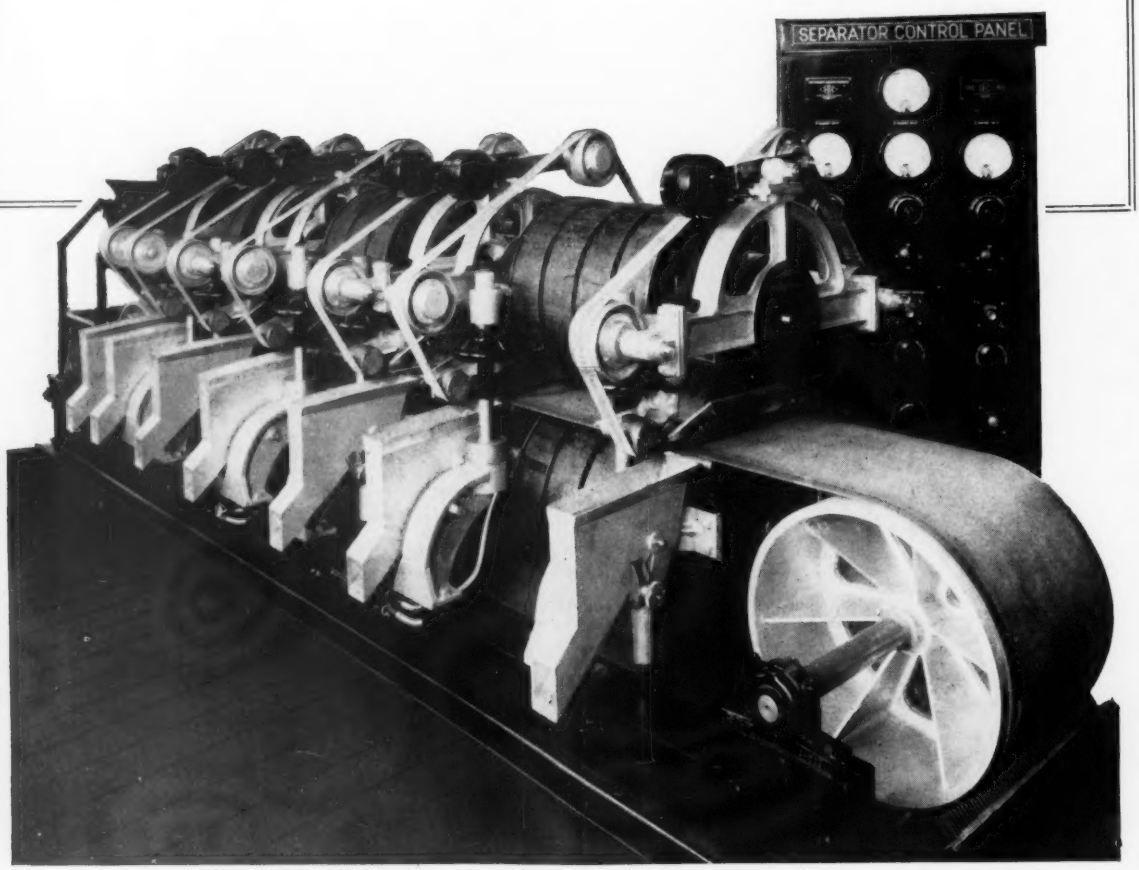

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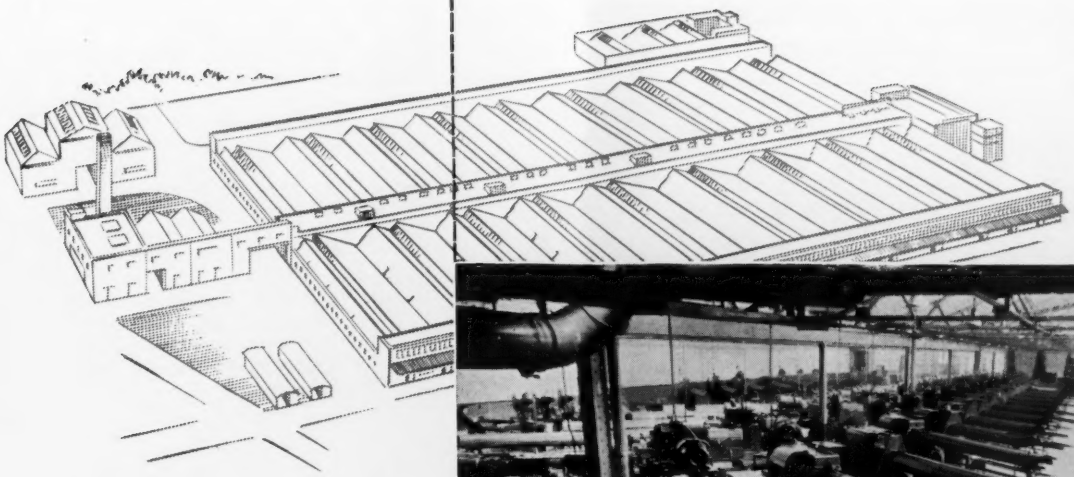

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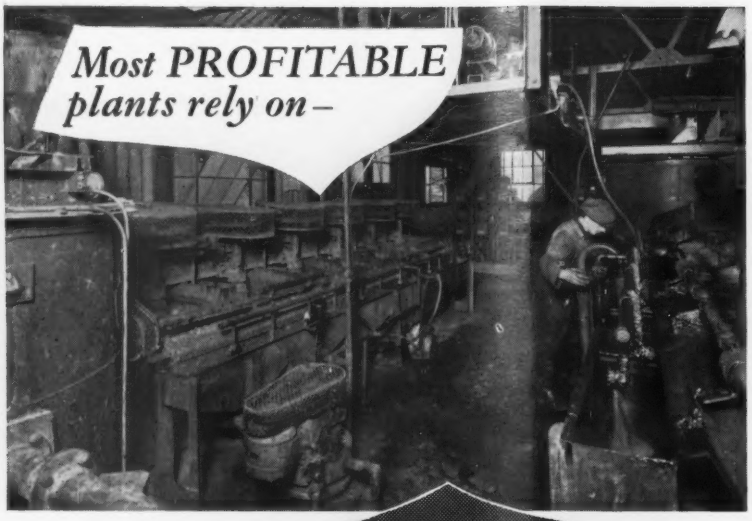

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Write for Bulletin No. F10/B50

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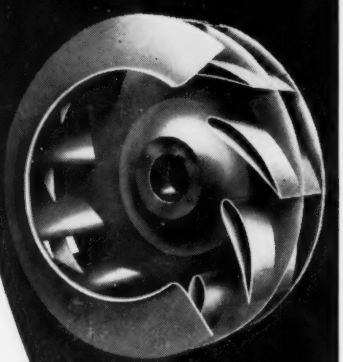

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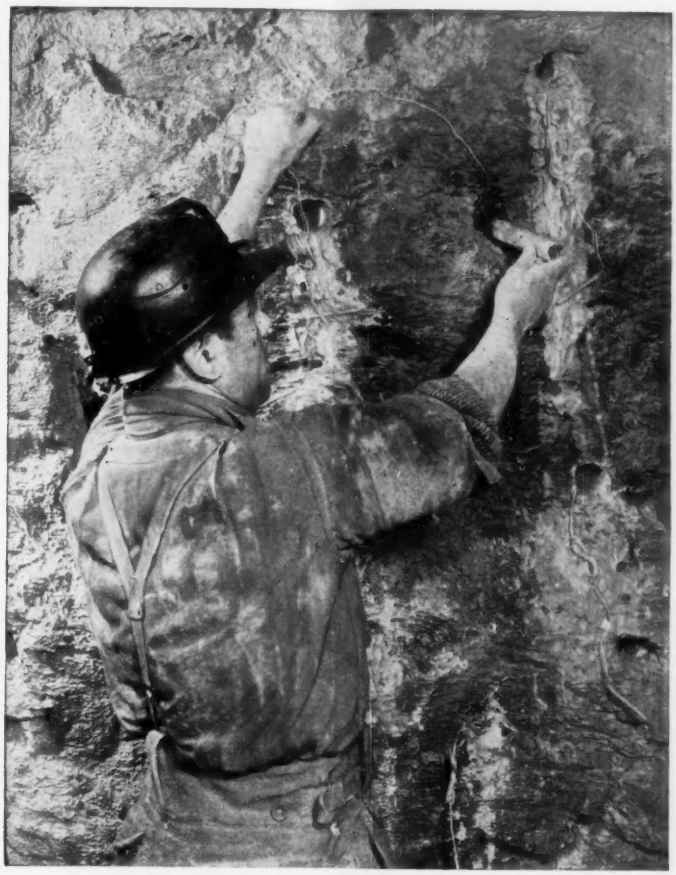

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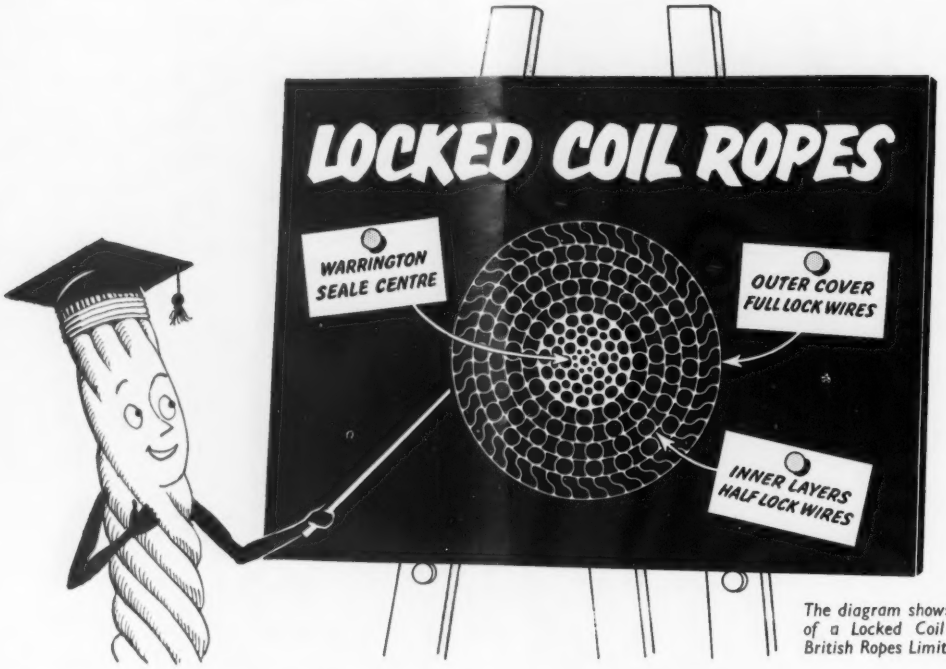
LEARNING THE ROPES



The diagram shows the end section of a Locked Coil rope made by British Ropes Limited.

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A typical application of Locked Coil rope

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The Mining Journal

Established 1835

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NOTES AND COMMENTS

The Long Term Outlook for U.S. Copper Production

It was, perhaps, sheer bad luck that the launching in the United States by the Copper and Bronze Research Association of a copper promotion campaign with the slogan "Plenty of Copper" should have coincided with the advent of the tightest squeeze in the metal in recent years. It is only fair to add that *Copper—To-day and To-morrow*, the pamphlet which opens the campaign, admits that "labour upsets . . . may produce temporary shortages."

But there is not merely a contrast between *Copper—To-day and To-morrow* and the tightness of nearby supplies on the date of publication, there is a more real contrast between the conclusions of the pamphlet and those of the Paley Report. There is no violent statistical conflict; nor should there be since the pamphlet draws its figures from the Bureau of Mines, the Bureau of Census and mining forecasts which appeared in the July, 1953, issue of *Engineering and Mining Journal*. But there is no mistaking the difference in flavour which finds expression chiefly in the role awarded to foreign supplies and in the unshakeable optimism of the C.A.B.R.A. report. Furthermore, although the Paley Report, understandably, had comparatively little to say on prices—its authors were reporting to a Government about availability only—the reticence of *Copper—To-day and To-morrow* is remarkable since it is directed by copper fabricators to actual and potential copper users.

Paley estimated American copper demand at 2,500,000 tons in 1975; C.A.B.R.A. estimates 2,300,000 tons usage in 1970 and therefore assumes a virtually identical rate of growth.

The basis of the Paley Report supply forecast was that, over the next 25 years, a long run domestic production capacity of 800,000 tons a year was "the highest it is safe to count on." In arriving at this figure the report took account of all known reserves, estimated at 25,000,000 tons, and the possibility of using even lower grade ore; it also took into account the possibility of proving an additional 10,000,000 tons of reserves and added "this tonnage must be counted on to help maintain an average annual output of 800,000 tons for the next 25 years" Only "the development of geological techniques as yet unknown" for finding ore bodies without surface indications would, in Paley's opinion, invalidate the supply forecast. Nevertheless the report did admit the possibility of an output of "a 1,000,000 tons or more . . . for a few years under the strong stimulation of high price and Government incentives."

C.A.B.R.A., on the other hand, assumes a net increase of 250,000 tons by 1956 in American domestic supplies which would make a total of 1,175,000 tons or 60 per cent of the then American demand of 1,940,000. This represents an increase in the share of the American market of 12 per cent and, be it noted, the forecast does not include advances in the treatment of low grade ores. These figures do not necessarily contradict Paley and, since the price of copper is undeniably attractive to producers and the metal is being stockpiled, may in fact be taken as supporting his view. What *does* seem a hazardous assumption is that American producers can increase their share of the American market by 12 per cent in competition with foreign producers, for that in turn assumes that conditions for expansion are relatively much more favourable in the United States than elsewhere. This was certainly not Paley's view for he believed that the foreign reserves in contrast to the American reserves, "can well support a large expansion of production."

The attitude of regarding foreign supplies as supplementary to and not as competitive with American-mined copper is tenable only as long as price is ignored. In his paper to the American Mining Congress (reported in last week's issue) Mr. S. D. Strauss, of the American Smelting and Refining Company said that he thought that there would be less use of copper if its price stuck at 30 c. a lb. than if it averaged 24 c. But he did not comment on whether there was enough demand to take the available supply at 30 c. The second question is the one that matters. A good many observers believe that 30 c. is too high to support the present world strike-free output. If they are right, and given normal competitive conditions, the operations on the lower grades of American ores would feel the pressure of price on costs earlier rather than later.

Here lies the weakness of the C.A.B.R.A. pamphlet; the user will be glad to know that copper will be plentiful, but he will be only mildly interested if it will be plentiful at a price at which he prefers to use aluminium. "You can now rate performance over availability" says a C.A.B.R.A. promotional announcement. This may not be enough;

especially when the user recalls that the present squeeze has its roots in the deliberate restriction of output by American mines in America and Chile.

In another respect C.A.B.R.A.'s pamphlet is more optimistic than Paley; the latter regarded the likely recovery of scrap in 1975 as about 700,000 tons; C.A.B.R.A. gives no figure but it is plain from a graph that the expected return is not far short of 900,000 tons.

Finally, C.A.B.R.A. gives no statistical estimate of the volume of American ore reserves but concludes that "reserves of ore appear adequate to maintain U.S. mine production at a high level for many years to come." C.A.B.R.A. would not presumably dissent from the Paley Report's estimate of known reserves but shows a much greater faith than the latter in the finding of new ores. The extent of the difference is not measurable, but since the volume of operations is influenced strongly by the volume of reserves the difference is of an important nature.

Nevertheless, if one compares only what is stated, and ignores what is omitted, the differences between Paley and C.A.B.R.A. are not vast. They certainly do not compare with some of the more vehement rebuttals that met the Paley Report in its earlier days.

Finance for the Camborne School of Mines

At a time when the problem of the future supply of mining graduates is seriously exercising some, although apparently not all, sections of the mining industry it is a matter of concern that this country's facilities for mining education should be adequate to the industry's requirements both quantitatively and qualitatively.

Quantitatively the existing facilities are fully able to absorb the number of new students at present coming forward each autumn. Whether this flow is anywhere near large enough for the combined long term requirements of the N.C.B. and of British overseas mining companies is of course another matter, but at all events, in the absence of any official indication to the contrary, colleges such as the Royal School of Mines and the Camborne School of Mines can scarcely be expected to plan for a much expanded intake.

Qualitatively the issue is largely one of finance, and here within limits it may be said that those mining colleges which are an integral part of one or other of our universities are adequately provided for through the increased university grants made available in recent years for the purpose of technical education and research.

The financial circumstances of the Camborne School of Mines, which is not incorporated in any university, are however somewhat less happy. Here we have an old established mining school of international repute and steeped in the historic tradition of Cornish mining offering a diploma which is widely accepted as the equivalent of a university degree. Officially however the C.S.M. has only the status of a technical college, and is something of a hybrid at that inasmuch as it draws the bulk of its grant direct from Ministry of Education, to which its governing body—selected mainly from the mining profession—is responsible. It thus fails to qualify either for assistance from university grants or for much more than token assistance from its local educational authority. The School is blessed with no endowments and beyond the Ministry grant of around £12,500 and the Cornwall County Council grant of £1,000 it is dependent entirely on its revenue from fees of 60 guineas a year which are still, in common with those of other mining schools in the country, at their pre-war level and can scarcely be increased unilaterally. At the same time the School's present annual expenditure of £22,000 has more than doubled since 1939 and even so is inadequate to present-day requirements.

Nobody who has visited the C.S.M. can fail to have been struck by the extremely modest and austere character of the amenities and there is no doubt that ideally the School should be in a position not only to install more up-to-date equipment, add to the staff and considerably improve facilities for research, but should also find the means for establishing a students' hostel and better social and recreational facilities so as to establish a full collegiate life as a background to the course. It is, however, not as yet clear how these necessary and, by present-day standards, quite unambitious requirements are to be financed.

On Thursday of last week three of the Duchy's five Members of Parliament paid a visit to the School and in the course of a subsequent press conference showed their awareness of the distinguished part played by the School in the training of engineers, who go from Cornwall to work in all parts of the world. If nowadays it is no longer entirely true that trade follows the flag, it can at least be said that trade follows the graduate engineer, as machinery manufacturers in every country will testify. In this connection the significance was not lost upon the Parliamentary visitors of the important contribution which a continuing supply of mining engineers trained in the Cornish tradition could make to the promotion of mining machinery exports not only from Cornwall but from the whole of this country.

The tone of these discussions lead us to wonder whether the solution to the School's difficulties may not lie in part in an appeal to British mining machinery manufacturers as well as to the British overseas mining companies to provide some of the additional revenue through endowment by covenant. Moreover if an appeal of this sort met with sympathetic response it might serve to pave the way for a successful appeal to the Ministry of Education to increase its direct grant.

In so far as British mining machinery manufacturers are concerned, the proposition is one which should have special appeal having regard to the day when diminishing requirements from our own coal industry must in due course pave the way for an intensification of export sales.

Rail Access to Manitouwadge Copper-Zinc-Silver Deposits

The Canadian Pacific Railway is to open up the promising Manitouwadge area of north-western Ontario. It will be recalled that our Canadian correspondent, writing from Montreal in April of this year, pointed out that the area comprises copper-zinc-silver deposits which at that time had been extensively diamond drilled at Geco Mines, and were unofficially estimated to contain an indicated 10,000,000 tons of ore. Latest reports from the same source appeared in last week's issue and presented an even more favourable picture, suggesting that indicated ore reserves may be as high as 14,000,000 tons. Gross values in copper, zinc and silver have been officially estimated at approximately $290,000,000 in the sections so far drilled. The plant at Geco Mines is being designed to treat 3,300 tons of ore daily.

These extensive deposits warrant railway facilities for the transportation of concentrates to the smelters of the Great Lakes and the United States, and the decision to construct a railway to the new mining field follows a detailed programme of aerial and land reconnaissance which was completed in August. The contract for the grading of a 40-mile branch line has been given to the Caswell Construction Company of Kirkland Lake. The line will run from Struthers to the main line 33 miles west of White River and north to Geco beyond Manitouwadge Lake, and construction will begin immediately.

M.J. Editor Retires After 53 Years

At the end of last month Mr. E. Baliol Scott retired from the Editorship of *The Mining Journal* after more than 53 years in the chair. This must be quite one of the longest editorships in contemporary journalism and is in keeping with the tradition of long service associated with *The Mining Journal*, which in all its 119 years of publication has had only seven editors. Although relinquishing the editorship Mr. Baliol Scott will still retain the chairmanship of the company, over whose fortunes he has so long presided, and his advice and experience will continue to be at the disposal of the editorial staff.

Mr. Edward Baliol Scott, Editor of *The Mining Journal* since 1901, was born in Sydney, N.S.W., on June 17, 1873. He is the son of Captain Laurence Hartshorne Scott of the 11th Regiment (Devonshires), A.D.C. to Sir William Dennison (the then Governor of New South Wales), and of Rebecca Bettington, grand-daughter of William Lawson, pioneer explorer and one of the discoverers of the Blue Mountains. He was educated first at Geelong Grammar School and then, after coming to England in 1886, at Bath College and University College, Oxford, where he took an honours degree in Greats. He was called to the Bar in 1897, and joined the Oxford Circuit, practising until the

R. Bruce Dunfield

E. Baliol Scott

Ursel Baliol Scott

increasing demands made on his time by *The Mining Journal*, in which his family already had an interest, obliged him to discontinue legal work. His legal background gave him a particular interest in mining law, and he has written extensively on safety and health conditions affecting mines throughout the world. He developed *The Mining Journal* service of special correspondents in the principal mining fields of the world, and in recent years has travelled widely to study changes in the mining fields consequent on the late war, with particular reference to the post-war prospects for British mining machinery. He has long been a recognized authority on mining economics.

The New Editors

Following Mr. E. Baliol Scott's retirement, Mr. Ursel Baliol Scott and Mr. R. Bruce Dunfield have been appointed Joint Editors.

Mr. Ursel Baliol Scott, a son of the retiring editor, was educated at Westminster and London University. He has been actively associated with *The Mining Journal* since the war and has been managing director since 1950. Pre-war, his activities were devoted to the advancement of industrial management, both as Secretary of the British Management Council (the forerunnner of the British Institute of Management) and as a member of the Secretariat of the International Committee for Scientific Management. During the war he made a notable contribution to the development of production control techniques. He has travelled widely in Europe and North America.

Mr. Dunfield, who has been assistant editor since 1951, joined *The Mining Journal* a year previously. He is a Canadian who combines, somewhat unusually, practical experience as a miner (he worked underground at McIntyre-Porcupine for some time before the war) with an economics degree at the London School of Economics and an interest in international affairs which led him to work for some years on the United Nations Secretariat in Paris and Geneva. He came over to England at the beginning of the war to volunteer for the Fleet Air Arm in which he served until 1945 attaining the rank of Lieutenant Commander.

Portugal

(From Our Own Correspondent)

Oporto, September 27.

A retrospect of Portuguese mining in general, and exports in particular, for the current year so far shows a heavy fall both in tonnages and values for the principal Portuguese minerals, tungsten and tin. Exporters know the cause of the catastrophic slide, and if anyone interested in Portuguese mining wishes to find the answer to a question often asked, perusal of the August 27 number of *The Mining Journal* and the article on "Indian Manganese Mining" will find the answer. Here it is: "It is instructive to note the disastrous results which can befall an industry when tax impositions are extended beyond the period and circumstance which enabled them to be easily administered and tolerably shouldered."

Prior to 1930, mining matters here were controlled by a series of regulations not always in the best interests of either State or industry, but in August, 1930, a new and very complete Law was published covering everything connected with mines, mining and export. This Law was compiled by practical mining engineers and safeguarded the interests of both State and industry while scheduling the only taxes payable as an area tax, imposed on the size of the concession, an "ad valorem" tax, based on 2 per cent of the average world market price of the ore and a tax not exceeding 25 per cent of the "ad valorem" tax payable to the Town Council of the main town in whose area the mine happens to be located. The Law of August, 1930, goes on to lay down that: *no other taxes are chargeable on mining concessions, minerals or the products resulting from the treatment of minerals.*

INTERPRETATION OF 1930 LAW

When imposing an "ad valorem" tax the legislator, presumably, had in mind just those exceptional increases in price resulting from such incidents as the Korean war, etc., as the higher the market price the heavier would be the tax and the greater the amount due to local government. This was the Law, at any rate on paper. The taxes imposed in 1950 are now less penal than they were a year ago, but the only way to enable exporters to compete with other producing countries would be to cancel all export taxes and respect the 1930 Law, which has not been interpreted as was intended. When this has been done perhaps outside capital will cease to regard investment here as a risk to be avoided.

The export figures for July are (in tonnes):—Tungsten ores: 386 (of which about 45 per cent is represented by exports of tungsten residues); Cassiterite: 39, practically all to the U.K.; Manganese: 500; Cupreous pyrites: 21,372; Haematite: 8,641; Magnetite: 3,520; Tin metal: 32.5; White arsenic: 101.5.

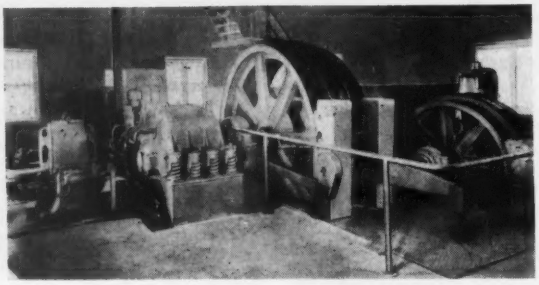
SWEDISH HOISTS—I

Simplified Control in Swedish Mine Hoists

The Bodäs iron ore mine of the Sandviken Steel Works is situated in Central Sweden near the steelworks which uses its entire production of ore to a total capacity of 135,000 tons per annum corresponding to 60,000 tons per annum of ferrous concentrate. Two friction drive hoists, manufactured by Allmanna Svenska Elektriska Aktiebolaget (ASEA), were put into service at Bodäs in 1947, and were designed to provide simplicity of control for a small mining property having no specially trained operating personnel. The following article by J. Ofverholm (Reunert and Lenz Ltd., South Africa), formerly of the industrial engineering department ASEA, is condensed from *ASEA Journal*, Vol. 27, and describes these hoists, while a subsequent article will discuss a pushbutton hoist designed by the same manufacturers to combine compact size with heavy load lift.

The two friction drive hoists at the Bodäs mine, Sweden, are set on the top floor of the concrete headframe and were taken into service in 1947. They were among the first pushbutton-operated multi-rope hoists installed in Sweden.

Originally, the ore hoist was planned as a friction drive hoist with one rope only, and rope diameter would have been 1¼ in. and pulley diameter 12 ft., but in order to save space and avoid deflection sheaves, an arrangement with two parallel ropes was finally chosen. The diameter of the rope could then be reduced to 1¼ in. and that of the pulley to 9.5 ft. The service hoist is also a two-rope hoist.



The two hoists, with the cage hoist to the rear

THE FRICTION HOISTS

The ore hoist is pushbutton-operated from two different loading stations and is provided with a combined bottom discharge skip and cage balanced by counterweight. The deepest level in service at present is at a depth of 800 ft., but future hoisting operations will take place from depths in excess of this figure.

The method of operation is that when the skip has been loaded the winder is started by a pushbutton near the measuring pocket. The skip automatically accelerates to full speed, travels up the shaft and slows down to creep speed immediately before its dump rollers enter the scrolls at the dumping station. The skip then stops in the dumping position.

After a short period the hoist automatically starts once more, progressing from creep speed until the door at the skip bottom is closed and then accelerating to full speed to the loading station where it slows down and stops for loading. For the occasional hoisting of heavy material the hoist is manually remote operated from the collar.

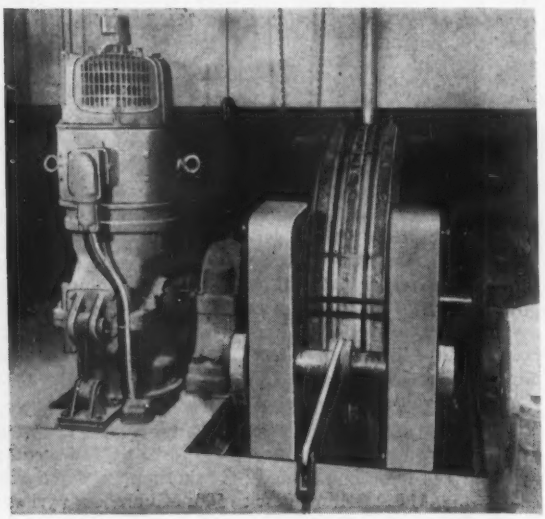
The service hoist is equipped with a cage balanced by counterweight, and is pushbutton-operated from within the cage and from nine different levels, the deepest at present being 800 ft. This cage is used for the transportation of men, timber and light materials, and control is effected by miners.

THE HEADFRAME UNIT

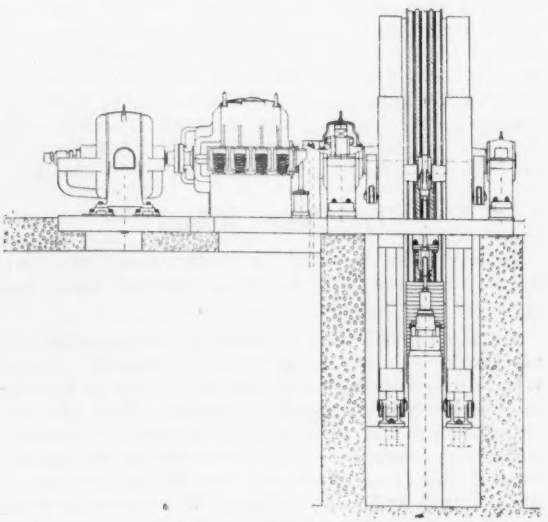
The headframe in which these hoists are housed is constructed of reinforced concrete, and in the same building are also installed a crushing and dressing plant, flotation plant, compressor installation, shops, supplies depot, and office. The headframe is 170 ft. high.

Dimensional statistics of the two friction hoists appear in tabular form immediately below.

SKIP HOIST		*CAGE HOIST*	
Useful load	4.4 tons	Useful load	0.95 tons (or 10 men)
Max. length of wind	1,900 ft.	Max. length of wind	1,900 ft.
Weight of skip	7.7 tons	Weight of cage	2 tons
Counterweight	10 tons	Counterweight	2.65 tons
Ropes	2 parallel 1¼ in. dia.	Ropes	2 parallel ¾ in. dia.
Pulley diameter	9.5 ft.	Pulley diameter	5.5 ft.
Present speed	660 ft./min.	Speed	1,000 ft./min.
Future speed	1,000 ft./min.	Hoist motor output	52 h.p.
Hoist motor output	136 h.p.		



The cage hoist with vertical motor and gear carried by the hoist shaft



The skip hoist showing the driving pulley and floating precision gear

The skip in dumping position

The cage with ore car

The Bodäs hoist installation is typical in so far that it belongs to a small mine having no specially trained personnel. The manufacturers have delivered similar equipment to mines of approximately the same size and situated even further away from industrial centres. Mines such as these can only afford to use machines which are safe and requiring little maintenance.

Consideration of the two hoists as separate units shows clearly how this combination of effective operation and reduced maintenance demand has been achieved.

SKIP HOIST DESIGN

The skip hoist consists of a driving pulley of all-welded construction of plate and rolled steel sections, provided with an insert of friction material in which a groove is turned for each rope. The friction rings of laminated leather are secured to the pulley by blocks and the drum is welded to rolled steel section spokes. The pulley is provided with a brake drum on either side, and its hub is shrunk onto a shaft of forged steel borne in two SKF roller bearings.

The floating precision gearbox is provided with hobbed double helical gears, totally enclosed in a cast-iron housing of rigid design and automatically lubricated. The high speed shaft is coupled to the motor shaft by a cast steel flexible coupling, while the gearbox is mounted on springs which enable it to follow the movement of the pulley shaft caused by the rope pull. The floating support of the gear eliminates not only the possible stress of pulley shaft bend, but also those caused by foundation settling or inaccuracy of levelling or alignment. In addition, the springs smooth out the load peaks which arise on starting and stopping.

Oscillation of the gearbox is eliminated by damping cylinders and, owing to the floating support, the use of roller bearings for all gear wheels and the precision manufacture, an efficiency of approximately 98 per cent is obtained and wear reduced to a minimum.

The hydraulic braking system consists of a combined service and emergency brake working on both brake drums of the pulley. The four brake posts have a common lever arrangement operated by a brake engine. This brake engine consists of an operating cylinder where the brake pressure is hydraulically developed and a safety brake cylinder, the piston of which supports the dropping weight. When an emergency stop occurs the safety brake is applied at the same time as the safety brake cylinder is discharged. Due to the rapid response and short travel of the service brake piston, the braking effort is applied by the service brake before the oil in the safety brake cylinder is able to escape and thus the falling weight remains freely suspended.

CONSTRUCTION OF CAGE HOISTS

The cage hoist is smaller than the skip hoist, but the design of the driving pulley and the braking system is much the same, and the principal difference between the two hoists consists in the arrangement of the gear drive.

The vertical hoist motor is flanged to the gear and the whole geared motor unit is carried by the hoist shaft so that hoist, gear and motor are mutually aligned. The object of the link between the gear and the ground is to prevent the gear from rotating around the slow speed shaft. The cage hoist is provided with a friction lining in the grooves of an aluminium alloy. As well as the service hoist cage, ASEA also delivered the bottom discharge skip with underhanging cage to the Bodäs mine.

The cage can move in guides within its frame so that cage and the ore car being transported can be rested on keps while the ropes are loaded by the skip and frame. The maximum vertical movement of the cage within its frame is about 1 ft. Automatic hoisting is interrupted with the skip in the dumping position when the dumping bin is full.

At the left section of the control cabinet panel for the service hoist are volt and ammeters for the D.C. circuit and the synchronous driving of the Leonard set. The panel contains in addition the fault indicating station where all causes of emergency stops are indicated. The right panel shows speed and depth indicators, while in front of the control panel is situated the master controller for manual operation of the hoist.

The skip hoist is manually operated from an operating desk when heavy materials and cars with rock are being raised. For this manual operation a signalling system built in the operating desk is used.

Development of Columbium in Arkansas, United States, During 1953

Because of the virtual lack of indigenous columbium-bearing ores in the United States, research work has been directed towards establishing an alternative source of supply, one of the most promising operations being the extraction of columbium from titaniferous Arkansas bauxites. The D.M.P.A. order for May, 1952, stimulated a world-wide search for and development of columbite resources and the following article, condensed from U.S. Bureau of Mines *Report of Investigations 5064*, by V. A. Nieberlein, M. M. Fine, W. A. Calhoun and E. W. Parsons, of the Bureau, describes the Arkansas bauxites and indicates the more promising of the columbite extraction processes so far considered in the United States. The chief purpose of the investigation is to determine the reserves of columbium minerals in Arkansas; to survey the important advances made in minerals extraction research; and to indicate the most likely line along which future progress may be made. During 1953 columbium has been concentrated in laboratory and pilot plant from approximately 0.07 per cent in the raw titanium minerals to more than 36 per cent columbium in the product.

All bauxite ores from the deposits in central Arkansas contain columbium-bearing ilmenite. Most of the bauxite mined in the district is treated in two local alumina plants, which discard the columbium-bearing ilmenite in the waste products—black sands and brown mud. Black sands, a coarse product separated early in the alumina process, and an intermediate product known as red mud comprise potential sources of columbium. An estimated 3,600,000 lb. of columbium would be contained in the annual plant feed with full-capacity operation.

The largest known columbium-bearing titanium deposit in the Magnet Cove area, Arkansas, is a rutile deposit of the Magnet Cove Titanium Corp. in the northern part of the basin. From 1932 to 1944, about 5,200 tons of rutile concentrates was produced from mining and milling operations on the property. The U.S. Bureau of Mines partly explored the deposit in 1945 and 1948 while the Christy brookite deposit on the east rim of Magnet Cove was explored to a limited extent in 1913 and in 1941 and the Hardy-Walsh titanium deposit, about half a mile north of the Christy, was prospected and sampled in 1941-42. Other known deposits of columbium-bearing titanium minerals, on which little or no exploration work has been done, include the Mo-Ti, Rutherford, and McKnight Placer. Columbium-titanium mineralization also occurs associated with syenitic intrusive rocks at Potash Sulphur Springs (Wilson Springs), five miles west of Magnet Cove.

The reserves of bauxite ore suitable for alumina production by present metallurgical practice, estimated at 44,000,000 s.tons (dry), contain an estimated 62,000,000 lb. of columbium. Impounded red mud and black sands, probably 2,000,000 tons of waste products from previous operations, are estimated to contain 4,800,000 lb. of columbium.

The ore reserves in the three columbium-bearing titania deposits investigated by the Bureau are estimated to be at least 8,000,000 tons containing four to eight per cent TiO_2 and 0.05 to 0.15 per cent Cb. The columbium content of these reserves is estimated to be 12,000,000 lb.

RECOVERY OF MAGNET COVE RUTILE

The recovery of rutile from the Magnet Cove property has been a matter of considerable interest since 1930 and from 1932 to 1942, about 5,200 tons of rutile were produced for overseas markets. Since that time, little commercial production of titanium mineral has been reported, but mineral-dressing research by the Bureau of Mines has been carried on to improve the milling processes for this and neighbouring properties.

When investigation of the Magnet Cove ore was resumed under the present D.M.P.A. contract; maximum recovery of the columbium rutile was stressed rather than high-grade TiO_2 concentrates. This was due to the fact that the rutile concentrate was no longer the final product as formerly but an intermediate, which must undergo an extractive process to separate and recover the columbium and titanium. Titanium minerals in the Magnet Cove ore were rutile, leucoxene, and altered sphene in sparing amount. Rutile varied considerably in size in the ore. The largest width of crystals observed was approximately 1½ cm.; smallest width, less than one micron, and much was free at minus-20-mesh.

THE CONCENTRATION PROCESS

The ore is associated with a substantial quantity of plastic clay, early removal of which is essential to the concentration process. The liquid-solid, or hydraulic, cyclone was found to be satisfactory for that purpose. A representative sample of the metallurgical composite was crushed and ground to pass 10-mesh and then pulped to a consistency of 10 per cent solids. The openings of the overflow and underflow orifices of the 5 in. cyclone were adjusted to what were considered optimum values, and, after the pulp was circulated for a few minutes, a sand-slime separation was effected under a feed pressure of 17 p.s.i. Removal of clay, while not complete, was adequate, and only 9.7 per cent of the titanium and 9.5 per cent of the columbium were lost in the slimes product. Flotation separation of pyrite analyzed, in per cent, 39.1 Fe, 38.6 S, 0.61 TiO_2, 0.01 Cb, and represented a loss of 1.4 and 1.3 per cent of the titanium and columbium respectively. Composite results of the gravity concentration operations showed that based on the original ore, a recovery of 52.7 per cent of the titanium and 54.6 per cent of the columbium was effected at a grade of 73.4 per cent TiO_2, and 1.05 per cent Cb.

More than 12 per cent each of the titanium and columbium remains in the table middling at a grade of 8.7 per cent TiO_2 and 0.12 Cb. Part of this rutile could undoubtedly be recovered by circulating the middling within the table circuit. Accordingly, the possibility of recovering the middling rutile by fine grinding and flotation is being investigated. Titanium and columbium in the middling have been recovered at a grade of 53.7 per cent TiO_2 and 0.80 per cent Cb. In terms of the crude mine run feed, this amounted to 7.8 and 6.1 per cent of the titanium and columbium, respectively. By combining the flotation and gravity concentrates a total of 60.5 per cent of the titanium and 60.7 per cent of the columbium was recovered in the laboratory experimentation at an average grade of 70.2 per cent TiO_2 and 1.01 per cent Cb.

Subsequent flotation research on various Magnet Cove products indicates that a substantial gain in recovery could be realized if an average concentrate grade of about 60 per cent TiO_2 were acceptable. It is not unreasonable to expect a further increase in recovery to 70 per cent at the 60 per cent TiO_2 grade.

In pilot plant operations work has totalled 168:20 hr. while treating 102.8 dry tons of ore. During this time 9.84 tons of concentrates have been made that contained 19.4 per

cent TiO_2, 0.38 per cent Cb, and 25.9 per cent Fe. This concentrate represents a recovery of 45.1 per cent of the total titania and 50.8 per cent of the total columbium. Work to date indicates the feasibility of recovering at least 50 per cent of the titanium and columbium by gravity processes.

COLUMBIUM-BEARING BAUXITE PRODUCTS

The chief resources of columbium-bearing titanium minerals include Arkansas bauxite and the waste and intermediate products of the alumina extractive industry. The average production of black sand, a waste product, is 8.55 per cent by weight of the ore processed. On this basis 219,000 tons of black sands represents the yearly production of this product. The black sand contains approximately 0.07 per cent Cb. The recovery of ilmenite and iron from black sands has been of interest for several years. A laboratory process developed in 1948 consisted of roasting, magnetic separation, and tabling the non-magnetic material. This treatment gave a recovery of 71.4 per cent of the total titanium and 77.3 per cent of the total iron.

The black sand consisted principally of siderite, siderite altered to magnetic iron oxides, partly altered kaolin, kaolin altered to sodium-aluminium silicate, with appreciable quantities of other materials. Basic operations of the pilot plant were modified to permit variations in the disposition of table middlings, and results of the total operational period showed that the gravity concentrate recovered 71.3 per cent of the total TiO_2, 64.8 per cent of the total Cb, and 44.9 per cent of the total Fe at a grade of 9.6 per cent TiO_2, 0.17 per cent Cb, and 41.3 per cent Fe. Magnetic roasting was employed to upgrade the gravity concentrate.

The net result of the pilot-plant campaign on black sand was a gravity concentrate that recovered 71.3 per cent of the total titania, 64.8 per cent of the total columbium, and 44.9 per cent of the total iron. Laboratory roasting and magnetic separation of the pilot-plant gravity concentrate resulted in a non-magnetic fraction that represented a recovery of 64.6 per cent of the total titanium and 61.6 per cent of the total columbium contained in the original black sands. From the data given it is estimated that, on a yearly basis, 17,300 tons of columbium-bearing titanium concentrate of the above analysis can be made. Similarly, the estimated iron concentrate that can be produced on a yearly basis is 52,000 tons.

PRODUCTION OF RED MUD

The red mud is an intermediate product made in the two major alumina extractive plants in the Bauxite area and represents approximately 53 per cent of the weight of the crude bauxite treated, and on a yearly basis would amount to about 1,354,000 tons, assuming that the plants operated at full rated capacity.

Of materials so far tested, the red mud represents one of the richest potential resources of columbium, but, as the pilot-plant tests revealed, it is also the least responsive to ore-dressing procedures for recovering the columbium-bearing minerals. This is primarily due to the fineness of the mud, which is 84.5 per cent minus-325-mesh. The results of a pilot-plant test showed a recovery of 6.5 per cent of the total titanium and 4.6 per cent of the total columbium in a product that represented 3 per cent of the weight of the original sample. This product contained, in per cent, 8.2 TiO_2, 0.23 Cb, 12.4 SiO_2, and 14.1 Fe_2O_3.

The estimated red mud made by the alumina industry in the Bauxite area on a yearly basis is 1,354,000 tons containing 0.09 to 0.17 per cent Cb, which represents a substantial source of columbium, but the negative results of gravity-concentration-tests on the red mud indicate that considerable basic research will be required to solve this problem. One phase of such a projected research programme could be an investigation of centrifugal processes as a means of concentration or in conjunction with other mineral dressing unit operations.

One of the major reserves of columbium-titanium minerals in Arkansas are the bauxite ores of Saline and Pulaski Counties. These materials contain small amounts of columbian ilmenite, some of which is later separated as black sands during alumina production by the Bayer process. A mineral-dressing study of a typical bauxite has been initiated, but because of the limited duration of the work, little progress can be reported. It is probable then that the recovery of columbian ilmenite from bauxite will necessitate a long range endeavour in the field of slime particle concentration.

EXTRACTION PROCEDURES

Among the extraction procedures for columbium the foremost seems the conventional double fluoride method, the basic current procedure on high-grade ore. Yet the type of columbium-bearing materials obtained from the Arkansas deposits are of such a nature that they can be rightly considered titanium minerals—not columbium ore. Roughly considered, the titanium content of the concentrate could be said to run about 25 to 50 times the Cb content, and so any process of Cb recovery must be an adjunct to the recovery of its principal constituent. In view of many technical considerations, the separation process may be summarized as the chlorination of the titanium and the columbium, and separation of their chlorides by fractional distillation. Since chlorination in itself can involve a number of procedures, several methods were chosen for opening and treating the concentrate so that the chlorination of a large excess of iron might be avoided, if possible. Three main approaches are :

(a) The first method consists in preparing a columbium-titanium matte by smelting the ternary mixture of pyrite-coke-titanium concentrate at 1,500 deg. C.

(b) The second scheme is the traditional analytical procedure of fusing the columbium-titanium concentrate with several times its weight of $NaHSO_4$ following later with chlorination.

(c) A third approach consists in grinding the columbium-titanium concentrate with coke and furnacing the mixture at 1,500 deg. C. or above the effect a reduction to the suboxides.

The method of coke reduction of ilmenite appears to be the most promising so far. A 3-kv.-a. induction furnace was first used to explore the composition variable, A series of sinters was prepared by mixing ilmenite and coke in increments of one per cent coke from 5 to 15 per cent and furnacing at approximately 1,500 deg. C. The recoveries of Cb in the sinter ranged from 74 per cent upward.

CONCLUSIONS

Of the extraction schemes so far investigated, all have some disadvantages. The most obvious separation of columbium from titanium is fractional distillation based on more than 100 deg. difference in the volatility of the chlorides.

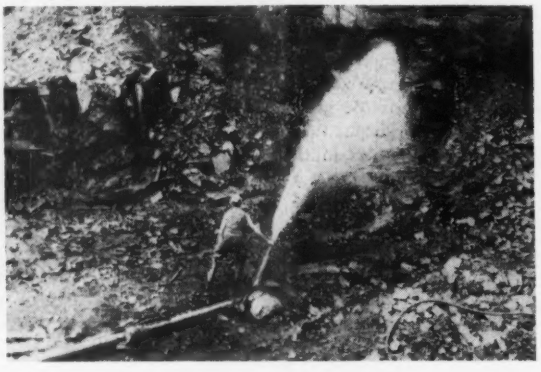
The various wet methods have some drawbacks in that a large preponderance of titanium adds a variable that is generally not taken into account, namely, that columbium and titanium in the presence of one another behave differently than either one separately. From the results so far obtained it does not seem unreasonable to expect both increased purity and increased yield in the future. As the chlorination technique is improved there is a definite possibility of eliminating the wet steps in the procedure.

Hydraulic Mining for Opencast Coal in New Zealand

The exploitation of minerals by hydraulic methods is standard mining practice, and the application of hydraulicking to the opencast coal mining industry is a departure of considerable interest. The New Zealand Government Mines Department is experiencing excellent results from the use of hydraulic mining methods in large-scale operations at opencast sites in the Buller district, South Island, and although it is reported that in the future hydraulicking may prove effective in underground coal exploitation at collieries in New Zealand, no definite report of this particular application of the system has yet been received. The following article briefly describes the method of hydraulic mining currently employed at the Stockton field, and points out that the topographical and climatic features of the district play a large part in its success

Hydraulic mining has traditionally been employed as a method of gold exploitation and currently is in use as a normal operating procedure at certain tin mining fields. Now the practice is being utilized by the New Zealand Government Mines Department at Stockton, in the Buller district of South Island, where a coal deposit is being worked more than half a mile above sea level.

Hydraulicking for coal is claimed as a unique procedure, and the method as employed at Stockton is proving so economical that it is considered the price of New Zealand coal will be considerably reduced as a result. Statistics show that this statement may yet be borne out by events as at the opencast face where the method is being employed a normal shift by two men produces some 200 tons of coal. Normal opencast operations employing mechanical excavators, are stated to yield an average output of somewhere in the neighbourhood of 30 tons per man per day.



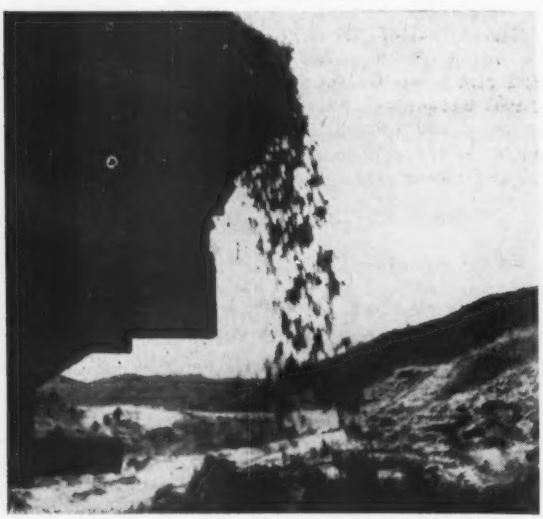
Hydro-mining operations at an opencast coal seam in Stockton, New Zealand

The essential requirements of hydraulic mining are an unlimited water supply, both for washing and for transporting the coal from the face, and a ground lie of sufficient gradient to maintain a natural flow of won spoil.

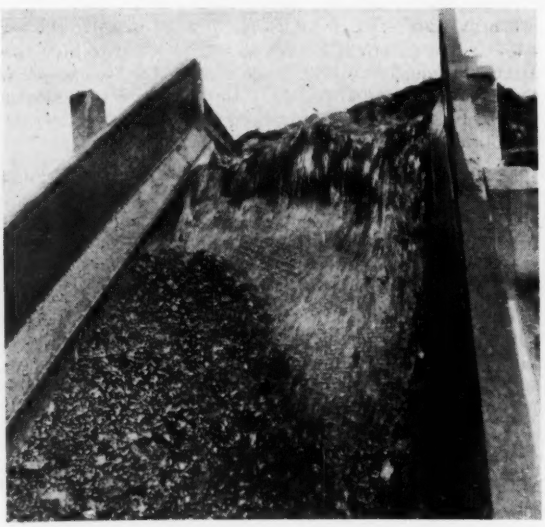
The Buller district is thus ideal for hydraulic mining practice, as rainfall is high and the country hilly. It has been shown that the minimum grade requirement for efficient hydraulic mining is approximately 1 : 130. The easier the ground gradient, the greater is the flow of water required to maintain a given output, and a gradient of approximately 1 :35 requires 5 cusecs to produce some 60 tons of coal per hour. (A cusec may be defined as 1 cu. ft. of water per sec.)

In the operational method at the Stockton face, water and coal run together down a wooden channel one mile in length, 16 in. in width at the bottom and 22 in. in width at the top. This channel terminates in a large wooden bin where the water passes through a metal grill to a race. The wet coal passes to a hopper of 200 ton capacity for direct loading on to trucks.

An interesting facet in the application of hydraulic mining to the winning of coal is that the method may soon be considered for underground mining operations at collieries in New Zealand. Its employment in this connection would entail the shooting of water under pressure into workings by miners who would not venture beyond the safety of properly secured areas. Coal pillars would be washed away in a progressive retreat towards the mine entrance, and it is considered that a highly economical extraction would be achieved.



Discharge of saturated coal into hopper



The screen retaining coal allows seepage of water

Extraction and Analysis of Metals

Research on new techniques for the extraction and analysis of valuable metals from minerals and ores is carried out by the Radiochemical Group of the Chemical Research Laboratory at Teddington. At an "Open Day" on September 28, some features of this work were shown to visitors in a modern laboratory designed for radiochemistry and opened in 1953.

Methods developed over the years for separating and analysing metals in radioactive ores are continuously being applied to other problems. For example, much interest is being taken at present in geochemical methods of prospecting, which call for the analysis of large numbers of soil samples for a variety of metals. High accuracy is not required, but speed and ease of operation are essential. The laboratory has developed a paper-strip chromatographic procedure for the detection and determination of metals in soil, which can be completed in less than 30 minutes. It employs upward diffusion of solvent in a suitably prepared sheet of filter paper and enables extracts from ten samples of soil to be treated simultaneously. This technique has been applied with good results to soils containing niobium, tantalum, copper, cobalt, uranium and lead.

DETERMINATION OF NIOBIUM AND TANTALUM

During the routine analysis of a wide variety of natural minerals and synthetic concentrates, the need arose for a rapid method for the determination of niobium and tantalum, that incorporated a quick and efficient method of sample breakdown. Published methods for the chemical separation of niobium and tantalum from other metals tend to be rather lengthy and are not generally applicable to all materials. A shortened chromatographic procedure has been developed for the extraction of the mixed oxides of tantalum and niobium from minerals and ores. It has been described by R. A. Mercer and R. A. Wells (*The Analyst*, June, 1954, Vol. 79, No. 939, p. 339-345). A solution of the sample in hydrofluoric acid containing ammonium fluoride is absorbed on cellulose and transferred to a 3 in. column of cellulose. The niobium and tantalum are completely extracted on passing 400 ml of ethyl methyl ketone containing 15 per cent v/v of 40 per cent w/v hydrofluoric acid through the column. The separation is complete from all metals other than tungsten. The two oxides from this solvent are subsequently separated by further chromatography or determined by colorimetric procedure.

Studies on the separation of platinum, palladium, rhodium and iridium by a chromatographic procedure using columns of cellulose and organic solvents have been largely completed. A new separation using paper-strip instead of columns has been devised. The metals were used as chlorides, the solvent being methylisobutylketone containing 40 per cent w/v hydrochloric acid as the separation solvent. On development with stannic iodide solutions the metals form very clear and well separated bands. A quantitative determination of the platinum metals on the paper-strip by the photometric method appears possible.

Research on the recovery of gold and other metals from cyanide solution has been continued. Earlier work has shown that iron and copper as complex cyanides are removed from Amberlite IRA 400 by sodium cyanide solution, whereas complex gold cyanide is not eluted. A pilot plant utilizing this effect in gold recovery is to be started in Southern Rhodesia.

As previously reported in *The Mining Journal* (March 26, 1954, p. 360), it has been established that the amount of gold in the resin is an important factor in the elution stage. If the loading of gold on the resin exceeds 0.1 g Au/g resin, gold is eluted to some degree by sodium cyanide. The quantity eluted increases with leaching until at saturation of the resin with gold some 60 per cent of the absorbed gold may be removed.

Attention has also been given to the behaviour of arsenic, antimony and selenium which might be present in cyanide solutions from gold ore treatment. It has been found that arsenic as arsenite is not absorbed under the conditions of the experiment (ph 12), but arsenate and thioarsenite are taken up by Amberlite IRA 400. This finding is particularly significant in view of the frequent presence of sulphides in gold ores.

TECHNICAL BRIEFS

Improved Production of Stainless Steel Powders

A patented process for producing prealloyed steel powders, that melts and disintegrates alloy steels to achieve complete homogeneity in all powder particles, has been developed by Vanadium-Alloys Company, U.S.A., according to a report in *Steel*. The company now makes stainless powders in grades 302-B, 316, 318, 318Si and 410. This development extends the usage of powder metallurgy to include high strength and corrosion resistant application.

The process calls for water disintegration of prealloyed molten metal. Steel of desired composition is melted and in the disintegrator the pencil-thin stream of molten metal is blasted into powder by water jets that emerge from a hollow rotating disc through 16 nozzles placed at the outer periphery. The disc rotates at 6,000 r.p.m. It is attached to the top of a hollow shaft through which water flows at low pressure. The mixture of water and powder is then pumped to a dewatering system. Most of the powder is collected in the cone, while extreme fines are collected in the vortrap. Undesired coarse particles may be separated in the classifier and discarded.

It is reported that practically any composition can be produced as prealloyed powder by this process, including carbon and alloy steels, stainless steels, tool steels, special purpose steel and high temperature alloys. Each presents different problems of production and adjustments in processing.

Protection by Chlorinated Natural Rubber Coatings

Mining plant and equipment are particularly susceptible to corrosion owing to the conditions under which operations are conducted, and paint for protective purposes is of importance. Detel Products Ltd., manufacturers of a range of chlorinated natural rubber coatings, recommend coats of their "A" Grade over a coat of "D.M.U." for the protection of iron and steel.

"D.M.U." is a zinc-laden primer which builds up during its life, becoming harder and more impermeable. It consists of over 96 per cent finely divided zinc, and its action resembles that of galvanization in preventing rust creep.

Detel "A" grade, which has a base of chlorinated rubber, is suitable for use on surfaces exposed to the action of fresh and salt water, corrosive fumes, mineral oils, and condensation and spillage of acids, alkalis and salts. It is an electrical insulator even after a long immersion in water, preventing electrolysis, a frequent cause of corrosion.

"D.M.U." together with Detel "A" grade is used in mining installations for the protection of pumping equipment.

Gas Plating

The possibility of using gas plating in industry has been discussed by J. E. Hyler (Finish 10, No. 11, 48, 56, 89, 1953). In such a process, the metal in a volatile form as, for example, the carbonyl, is deposited by thermal decomposition. Thick deposits of high quality can readily be obtained by this technique and no difficulty is experienced in the plating of parts fabricated by powder metallurgy. It will be remembered that the plating of powder metallurgy parts by conventional methods is rendered difficult by the possibility of entrapment of corrosive liquids. In the case of carbonyl plating, the only waste produced is carbon monoxide which may be burned or vented to the atmosphere. It would appear that processes such as this, with their special advantages and applications, are likely to be of considerable commercial value.

A Series of Airborne Scintillometer Maps

The senior representative of the Department of Natural Development, Australia House, informs us that maps covering the Ban Ban area in Northern Territory adjoining the Rum Jungle area in a south-easterly direction are available for public inspection on application at Australia House. These maps are on view only, and cannot be purchased.

It is hoped that maps of further areas will be available from time to time. This particular series is of the radioactive anomalies of the area.

METALS, MINERALS AND ALLOYS

The recent sharp increases in the London prices of copper and lead, though due to somewhat different causes, are both in part a reflection of the continued tendency for consumers (especially in this country, but to a greater or lesser extent everywhere) to operate on a smaller margin of stocks than would have been considered prudent before the war. In part this is due to the much increased working capital required to carry stocks at post-war prices. But in part, also, they have been conditioned to much reduced stock levels as a result of a period of more than ten years of controls, during and after the war, in which stocks were in effect carried for them by the Government. Consequently, with the return to free trading they have been slow to revert to the re-establishment of stock levels which would insulate them against short-term price fluctuations, and the continuance of hand to mouth buying has meant that many consumers have been forced to buy at a time of temporary market shortage, where before the war they could have afforded to sit back and wait. The effect of this has inevitably been to aggravate price fluctuations.

It is, of course, true that present high prices are only being paid for the marginal supplies coming onto the Metal Exchange, and that the bulk of production is being delivered direct from producer to user under long-term contracts. At the same time these sudden and unexpected price increases are extremely bad publicity for the base metals. As Mr. Simon D. Strauss pointed out to the American Mining Congress a fortnight ago, price stability is an important market factor in favour of aluminium against the much more erratically priced base metals. This is a fact to which the American copper industry is obviously highly sensitive, witness the present determination of the U.S. domestic producers and custom smelters to keep their price at 30 c. with strict rationing of deliveries.

So far as this country is concerned, it seems to us that in the long run someone has got to replace the Government as a substantial stockholder, and if through the years of control the buying habits of the consumer have become permanently changed, it may well be that Commonwealth producers, who have already had to re-assume the responsibility for carrying pipeline stocks, may, in the interests of price stabilization, have to go a stage further and build up more substantial stocks at the point of sale. This would seem to be especially necessary during periods of falling prices when consumers are inclined to run stocks down to bed rock in anticipation of further falls. It may well be that part of the present squeeze in copper is due to the universal inclination to bear copper last autumn and during the early part of this year.

COPPER.—Aside from U.S. copper producers and custom smelters who, presumably for the reasons suggested above, continue to adhere to a 30 c. quotation, copper prices, both in New York and London recorded further sharp increases until Tuesday of this week. Thereafter the London price reacted and on the week finished little above our quotation of a week ago at £290. Early in the week dealers in the States had been bid as high as 36 c. for prompt metal.

Several independent U.S. copper manufacturers, more particularly wire mills, are reported to be within a fortnight of having to close down owing to lack of metal . The U.S. Bureau of Foreign Commerce is reported to have under consideration a proposal to control U.S. copper exports in all forms including scrap.

Market sentiment was severely effected by the U.S. Government's decision last Thursday not to divert forthcoming stockpile deliveries to consumers. It would appear that this decision was influenced mainly by the belief that such action, if taken while strikes in the domestic copper industry were still going on, would be widely interpreted as strike breaking, a risk which the Administration was understandably in no mood to take with the November elections so close. The fact that the withholding of copper might create an even more unfortunate labour situation through widespread unemployment was clearly considered the lesser of two evils. It may well be that if, as now seems more likely, the various strikes, in which the Mine-Mill Union is involved, may soon be settled, the Administration will then feel free to reconsider its decision.

On the strike front, the latest news is that an agreement has been reached ending the seven weeks strike at the three plants of the American Brass Co. The agreement, which is still subject to union ratification, is estimated to be worth an increase of 10 c. an hour. Meanwhile negotiations were due to be resumed last Tuesday over the stoppages at Anaconda's Montana operations and the A.S. and R. smelter and Kennecott refinery at Garfield.

Marketwise, the strike news from Chile has been more encouraging with reports at the end of last week that the Braden Copper Company which had hitherto been disassociating itself from the terms on which the Chilean Government persuaded the El Teniénte strikers to return to work, had finally agreed to grant wage increases estimated to cost the company 200,000,000 pesos per annum equivalent to about $3,800,00. What *quid pro quo* if any has been offered to the company in return for this concession may become apparant once the terms of the new mining laws are published.

As if the Chilean and American copper strikes were not enough, the difficulties of the present supply position seem likely to be intensified by the steadily deteriorating coal supply position on the Copperbelt. Mine offifficials were anticipating this week that production might have to be seriously curtailed by the end of the month. As in previous fuel crises the electrolytic refineries would be the first to reduce output, followed if necessary by the smelters. Every effort would be made to maintain the rate of ore hoisting and to stockpile concentrates until the fuel position improves. Just how much leeway has to be made up on this score is illustrated by the fact that while the mines of the copperbelt require, in all, some 90,000 tons of coal a month deliveries in September were about 48,000. Although the bottleneck is on the railways it has come about not so much from inefficient transport management as from the fact that the railway system has been called upon to carry a rapidly increasing volume of traffic. Energetic measures are now being taken to divert traffic from rail to road haulage wherever possible, and to speed up the unloading of wagons, pending the delivery of more locos and rolling stock.

LEAD AND ZINC.—The past week has witnessed a sharp rise in the London lead price which on Tuesday of this week reached a high point of £110. The immediate cause of this increase is no doubt nervousness due to the stoppage at the Port of London, which in turn, is another example of what can happen to prices when stocks are none too plentiful.

The U.S. price moved in sympathy with London during the week, and by Tuesday all leading producers were quoting 15 c. The increase was made with some reluctance as it was felt in the trade that this might have the effect of causing the G.S.A. to reduce its stockpiling intake, and indeed this may already have happened, as on Wednesday the G.S.A. invited offers for domestic zinc for its monthly stockpile purchase, but has so far made no enquiries for lead.

There is no question that a major factor in the recovery of lead and zinc prices in recent weeks has been the psychological boost to sentiment following the announcement of the U.S. Government's new long-term stockpiling programme. It may be that the Government's readiness to buy up to 200,000 tons of lead in the year to June, 1955, has been interpreted as a definite intention to do so. In fact, of course, this figure represents a maximum Government commitment under its price support policy, and it may well be that at 15 c. the Administration feels that lead can stand on its own feet.

Zinc prices also firmed up in London during he early part of the week but New York remained unchanged at 11½ c.

TIN.—The tin market has been entirely featureless, with the London cash price virtually unchanged from a week ago at £735. Short of a major business recession in the States on the one hand, or on the other the freezing of a portion of the producers output to meet eventual buffer stock commitments, it is difficult to see why there should be any major disturbance in the tin market for the next few months. Even these two contingencies do not appear to be matters of immediate concern.

COBALT.—At the beginning of this month International Nickel announced the initiation of the first electrolytic cobalt refinery in Canada at their Port Colborne works. Hitherto, Inco's cobalt output has been marketed as oxides and salts through its refinery at Clydach in Wales. The opening of the new refinery means that in future the company will be in a position to market a high purity cobalt.

NICKEL.—Inco which already has substantial long-term contracts with the G.S.A. has now undertaken additionally to deliver a further 2,250 s.tons of refined nickel during the next ten months. This production will come not from the company's own mines, but as excess production from Sherritt Gordon's Lynn Lake mines, which is in excess of the capacity of the latter company's refinery at Fort Saskatchewan. Sherritt Gordon's own scheduled production of 9,000 s.tons of refined nickel this year remains unaffected.

Iron and Steel

Only after the event have the effects of the sharp drop in iron and steel production during July and August become fully apparent. Requirements of the big consuming industries have continued to increase and although outputs have now been restored to the high levels of the second quarter of the year, supplies of many types of steel fall considerably short of requirements.

Expansion of capacity is continuous. The president of the British Iron and Steel Federation has stated that during the past ten years, expenditure on new equipment has been running at the rate of £1,000,000 a week, but equilibrium between supply and demand has not yet been attained.

One advantage of the abundance of specifications is that rolling programmes can be arranged over fairly long periods, but there is quite a big volume of business waiting to be placed as soon as works are in a position to enter into new commitments.

Pig iron production is now running at the rate of over a million tons a month but the great bulk of the ouput consists of basic iron for use in the open hearth steel plants and outputs of haematite and low and medium phosphorous iron are insufficient. A better demand for high phosphorous iron reflects the improved conditions in the light castings industry and the consumption of both iron and steel scrap is steadily rising.

Throughout the first three quarters of this year there has been a drop of over 50 per cent in the imports of iron and steel, but that trend may have to be reversed. The boom in the sheet trade and the sharp upsurge of demand for re-rolled bars and sections has given a big impetus to the call for billets, slabs and sheet bars and British steel makers are finding it difficult to meet all requirements. Moreover, although re-rollers now have plenty of work they complain that present prices hardly cover the cost of production. Unlike the rollers of sheets, plates and heavy sections they are unable to get premium prices for export orders and are consequently not keen to accept some of the business offered.

An acute shortage of wire rods has also developed and some of the smaller wire mills are operating under serious difficulties.

The London Metal Market

(From Our Metal Exchange Correspondent)

Tin is still a dull market, and with no new developments of note price movements have been small. Supplies seem ample for consumers' requirements, and there seems to be no reason to expect much change either upward or downwards for the time being. In America the market has remained steady, but the doc!. strike there may stimulate some demand for immediate delivery. On Thursday morning the Eastern price was equivalent to £743½ per ton c.i.f. Europe.

Copper has been very active, and early this week over £300 per ton was paid for the cash position whilst three months also registered a new peak; this was followed by a moderate reaction which was probably overdue. In America the high prices in London are causing talk of higher prices for U.S. copper, but the custom smelters and producers are keeping to the 30 c. quotation although they can only fill part of their customers' requirements. Copper for export is scarce, and bids of as much as 36 c. f.a.s. New York for electrolytic copper for October delivery guaranteed, and 35 c. for November guaranteed, are reported. Scrap is also in demand, and it has been suggested that restrictions should be imposed on the export of all kinds of copper. Chile, it is understood, expects to announce export prices for the metal shortly.

Lead continues to advance, and, with supplies of metal for early arrival in Europe none too plentiful, the backwardation is widening and the position is being aggravated by the London dock strike. In America some producers have increased their price to 15 c. per lb. and a moderate demand is reported.

Zinc in sympathy with other metals staged a sharp advance on Tuesday, but the peak prices were not maintained. Demand by the trade here continues at a satisfactory rate, and in America it is said to be fair.

Closing prices and turnovers are given in the following table :

	September 30		October 7	
	Buyers	*Sellers*	*Buyers*	*Sellers*
Tin				
Cash	£732½	£733	£734	£735
Three months	£733	£734	£733½	£734
Settlement	£733		£735	
Week's turnover	520 tons		475 tons	
Lead				
Current month	£103¾	£104	£110	£110¼
Three months	£100¼	£101	£104¾	£105
Week's turnover	4,575 tons		5,050 tons	
Zinc				
Current month	£81	£81¼	£83	£83¼
Three months	£81¼	£81½	£82¾	£83
Week's turnover	2,625 tons		5,600 tons	
Copper				
Cash	£280	£282½	£285	£290
Three months	£264	£265	£268	£270
Settlement	£282½		£290	
Week's turnover	5,050 tons		8,400 tons	

OTHER LONDON PRICES — OCTOBER 7

ANTIMONY

English (99%) delivered, 10 cwt. and over .. .. £210 per ton
Crude (70%) .. .. .. £200 per ton
Ore (60% basis) .. .. .. 22s./24s. nom. per unit, c.i.f.

NICKEL

99.5% (home trade) .. .. £483 per ton

OTHER METALS

Aluminium, 99.5%, £156 per ton
Bismuth (min. 2 cwt. lots) 16s. lb.
Cadmium (Empire), nominal
Chromium, 6s. 5d./7s. lb.
Cobalt, 21s. lb.
Gold, 250s. 5d. f.oz.
Iridium, £45 oz. nom.
Magnesium, 2s. 4d. lb.
Manganese Metal (96%-98%) £225/£262
Osmiridium, £40 oz. nom.
Osmium, £50 oz. nom.
Palladium, £7 oz.
Platinum, £30/£31
Rhodium, £42 oz.
Ruthenium, £22 10s. oz.
Quicksilver, £105 ex-warehouse
Selenium, 35s. 9d. nom. per lb.
Silver 73¾d. f.oz. spot and 73½d. f'd.
Tellurium, 15s./16s. lb.

ORES, ALLOYS, ETC.

Bismuth .. .. 65% 8s. 6d. lb. c.i.f.
60% 8s. 3d. lb. c.i.f.
Chrome Ore—
Rhodesian Metallurgical (semi-friable) 48% £12 8s. 0d. per ton c.i.f.
,, Refractory 45% .. £12 14s. 0d. per ton c.i.f.
,, Smalls 44% .. £8 5s. 6d. per ton c.i.f.
Magnesite, ground calcined .. £26-£27 d/d
Magnesite, Raw .. .. .. £10 - £11 d/d
Molybdenite (85% basis) .. .. 102s. 4d. - 103s. per unit c.i.f.
Wolfram and Scheelite (65%) .. 182s. 6d. - U.K. Gov't Stock d/d 192s. 6d. plus charges
,, ,, ,, ...
Tungsten Metal Powder (98% Min. W.) .. .. 17s. 0d. nom. per lb. (home)
Ferro-tungsten .. .. .. 14s. 0d. nom. per lb. (home)
Carbide, 4-cwt. lots .. .. £37 6s. 3d. d/d per ton
Ferro-manganese, home .. .. £54 15s. 0d. per ton
Manganese Ore Indian c.i.f. Europe (46%-48%) .. .. .. 68d./70d. per unit nom.
Brass Wire .. .. 2s. 11½d. per lb. basis
Brass Tubes, solid drawn .. .. 2s. 4½d. per lb. basis

THE MINING MARKETS

(By Our Stock Exchange Correspondent)

Stock markets which finished last week in an uncertain mood turned firm on Tuesday. Gilt-edged were steady in a narrow market and there was a sound undertone due to the satisfactory conclusion of the Nine Power Conference.

Kaffirs suffered from end of account influences and contango difficulties. The September monthly returns were not available until after the close of business on Friday. Finance house prices, like other issues, were affected by the news of fresh flotations and market conditions were, on the whole, disappointing. Consolidated Goldfields and West Witwatersrand were almost the only firm spots. These received favourable mention in the daily press. Anglo American's quotation was unaffected by the news that its interim dividend would be unchanged from last year at 20 per cent.

Among individual Rand mines, price changes were mainly ruled by the September returns. An overall increase in gold value of 1/3d. per oz. had a good effect on some companies' profits and it is noteworthy that operating costs in many cases remained relatively stable. Features were a rise in Brakpan which was aided by improved results and press comment. Crown Mines went ahead without any particular reason being assigned to the rise. Simmer and Jack, another old low grade property, rose from their recent low level; profits were up by some £3,000 despite the lower tonnage milled. Fairly sharp declines occurred, however, in Daggafontein, Western Reefs and West Rand Consolidated. The latter are still making substantial losses on gold production. The new Buffels property will shortly be floated off. The 10s. shares are being offered at 16s. The mine is situated near Hartebeestefontein and Stilfontein.

As usual, the main interest was in the Orange Free State and the focal point was the new Saaiplaas mine which will shortly be put on the market by New Consolidated Goldfields. It is situated north of Harmony and Virginia and east of President Steyn. The reefs here are at a depth of 6,000 ft. but drilling results were not unpromising. It is understood that, geologically the ground is similar to Harmony and this raises the question of whether the property will become a uranium producer. It will be a long time before the shafts are sunk and underground results can be obtained. Full details of the three for ten offer of new shares in Virginia were issued during the past week. It is intended to extend the uranium plant at a cost of some £680,000. The initial profit from Harmony was considered good at £32,000. An exception to the easier trend was Western Holdings, whose September profits were some £10,000 higher than the previous month.

Western Australias were easier except for some speculative interest in North Kalgurli. Western Mining are making a new issue of one for three at 12s. 6d. This appears to be cutting it rather fine in view of the current market price. The money is required to finance the company's interest in gold, uranium and oil.

Diamonds and platinum turned easier. De Beers deferred fell after the lower quarterly sales figures. Results, however, were considered generally satisfactory and gem sales were well above the 1953 figure for the year to date.

Despite the rise in the price of copper many shares in this section were below their recent peak although some small gains were recorded. An official labour and wage settlement has been reached in Chile which is intended to last until January, 1956. Rhokana are seeking borrowing powers to raise another £7,500,000. These are not intended for immediate use.

Eastern tin shares were mixed. Recent favourites again advanced and Hong Kong also rose due to their modernized dredge coming into commission. Recent anxiety concerning the company's ore reserve position has been allayed.

Lead/zinc were better due to the sharp jump in the metal price. City circles are uncertain how long this may last as it is due, to some extent, to the London dock strike and also to the reappearance of Russian buying on a difficult market.

FINANCE	Price Oct. 6	+ or — on week
African & European	3⅜	—⅛
Anglo American Corpn.	8 1/16	—7/32
Anglo-French	26/3	.....
Anglo Transvaal Consol.	28/9	—1/3
Central Mining (£1 shrs.)	47/9	+3d
Consolidated Goldfields	58/-	+9d
Consol. Mines Selection	43/1½	—7½d
East Rand Consols	3/7½	.....
General Mining	5⅛	.....
H.E. Prop. 5/- Shares	12/-	+6d
Henderson's Transvaal	8/-	.....
Johnnies	51/7½ XD	—10½d
Rand Mines	3 1/16	—⅛
Rand Selection	45/-	—1/10½
Union Corp. (2/6 units)	38/9	—9d
Vereeniging Estates	4¼	—⅛
Writs	38/1½	—1/10½
West Wits	46/3	+3d
RAND GOLD		
Blyvoors	33/-	—1/6
Brakpan	8/3	+6d
City Deep	15/-	.....
Consol. Main Reef	20/-	—7½d
Crown	43/9	+1/3
Daggas	70/9	—1/9
Doornfontein	33/3	—9d
Durban Deep	31/3	.....
E. Daggas	12/3	+3d
E. Geduld (4/- units)	28/6	—3d
E. Rand Props	2 1/32	—1/16
Geduld	3¼	—1/16
Govt. Areas	12/6	—3d
Grootvlei	18/6	—6d
Libanon	10/-	—6d
Luipaards Vlei	24/3	—1/-
Marievale	20/-	.....
Modderfontein East	16/3	.....
New Kleinfontein	12/3	.....
New Pioneer	18/-	—1/3
Randfontein	70/-	.....
Robinson Deep	22/6	.....
Rose Deep	12/9	—9d
Simmer & Jack	4/7½	+6d
S.A. Lands	23/1½	—7½d
Springs	3/4½	—1½d
Stilfontein	28/-	—9d
Sub Nigel	40/-	—7½d
Van Dyk	4/6	.....
Venterspost	13/3	+1/-
Vlakfontein	15/6	—3d
Vogelstruisbult	35/6	—9d
West Driefontein	6½	—⅛
W. Rand Consolidated	53/9	—1/10½
Western Reefs	47/6	—1/10½
O.F.S.		
Freddies	8/-	—9d
Freddies Consolidated	22/-	—2/-
F. S. Geduld	5 1/2	—⅛
Geoffries	20/3	—2/3
Harmony	43/3	—1/-
Loraine	16/3	—1/3
Lydenburg Estates	22/6	—3/1½
Merriespruit	12/3	—9d
Middle Wits	20/9	—7½d
Ofsits	78/9	—4/4½
President Brand	76/-	—3/-
President Steyn	42/3	—2/9
St. Helena	32/-	—1/9
Virginia Ord.	15/9	—7½d
Welkom	30/9	—2/-
Western Holdings	5 1/16	+1/32
WEST AFRICAN GOLD		
Amalgamated Banket	1/10½	—1½d
Ariston	7/1½	—3d
Ashanti	22/7½ XD	+1½d
Bibiani	5/-XD	.....
Bremang	1/10½	.....
G.C. Main Reef	4/-	+1½d
Konongo	2/10½	+1½d
Lyndhurst Deep	1/1½	.....
Marlu	1/6	+1½d
Taquah & Abosso	3/4½	.....
W. Selection & Dev	8/3	.....
AUSTRALIAN GOLD		
Boulder Perseverance	9/-XD	.....
Gold Mines of Kalgoorlie	15/6XD	—4½d
Great Boulder Prop.	8/9	.....
Lake View and Star	16/3	—3d
Mount Morgan	18/9XD	.....
North Kalgurli	9/9XD	+7½d
Sons of Gwalia	5/-	—3d
Western Mining	12/1½ XD	—1½
MISCELLANEOUS GOLD		
Cam and Motor	9/-	.....
Champion Reef	4/9	.....
Falcon Mines	8/-	.....
Globe & Phoenix	24/-	.....
G.F. Rhodesian	7/6	—3d
London & Rhodesian	4/10½	.....
Motapa	1/9	.....
Mysore	5/1½	—4½d
Nundydroog	6/-	—7½d
Ooregum	4/6	—3d
St. John d'el Rey	16/-	—3d
Zams	39/6	—6d
DIAMONDS & PLATINUM		
Anglo American Inv.	7⅞	+⅛
Casts	27/9	—6d
Cons. Diam. of S.W.A.	6½	.....
De Beers Defd. Bearer	5 3/8	—7/32
De Beers Pfd. Bearer	18¼	+⅛
Pots Platinum	10/9	—1½d
Watervaal	16/9	—3d
COPPER		
Chartered	88/1½	—1/10½
Esperanza	5/9	+4½d
Indian Copper	5/-	.....
Messina	5 1/16	.....
Nchanga	11 1/16	+⅛
Rhod. Anglo-American	84/6	—6d
Rhod. Katanga	10/-	—7½d
Rhodesian Selection	23/9	—6d
Rhokana	28½	—¼
Rio Tinto	37½	—1½
Roan Antelope	21/9	+10½d
Selection Trust	52/6	+1/9
Tanks	5 5/16	+⅛
Tharsis Sulphur Br.	6¼	+⅛
TIN (Eastern)		
Ayer Hitam	27/3XD	.....
Gopeng	8/3XD	+1½d
Hongkong	8/1½	+7½d
Ipoh	19/9	—3d
Kamunting	7/6XD	—3d
Kepong Dredging	4/10½	+4½d
Kinta Tin Mines	10/3XD	.....
Malayan Dredging	27/3	.....
Pahang	11/1½	—3d
Pengkalen	9/-	+3d
Petaling	7/6	—1½d
Rambutan	16/6	—3d
Siamese Tin	7/-	—3d
Southern Kinta	18/6XD	—6d
S. Malayan	26/6	+1/-
S. Tronoh	9/6	.....
Sungei Kinta	10/6	.....
Tekka Taiping	5/4½	+3d
Tronoh	26/6XD	—6d
TIN (Nigerian and Miscellaneous)		
Amalgamated Tin	14/9XD	—3d
Beralt Tin	22/9XD	—2/9
Bisichi	6/10½	—1½d
British Tin Inv.	16/9	+6d
Ex-Lands Nigeria	3/1½	.....
Geevor Tin	13/3	—3d
Gold & Base Metal	3/-	.....
Jantar Nigeria	9/6	—1½d
Jos Tin Area	13/6	.....
TIN (Nigerian and Miscellaneous) contd.		
Kaduna Prospectors	2/6	.....
Kaduna Syndicate	2/6	.....
London Tin	6/6	.....
United Tin	3/1½	.....
SILVER, LEAD, ZINC		
Broken Hill South	53/1½	—10½d
Burma Mines	2/3	.....
Consol. Zinc	40/-	+1/10½
Lake George	8/1½	—1½d
Mount Isa	47/3	+1/-
New Broken Hill	32/6	+1/6
North Broken Hill	67/6	.....
Rhodesian Broken Hill	12/7½	+4½d
San Francisco Mines	22/6	+6d
Uruwira	4/4½	.....
MISCELLANEOUS BASE METALS & COAL		
Amal. Collieries of S.A.	48/9	.....
Associated Manganese	45/4½	—3d
Cape Asbestos	26/9	+1½d
C.P. Manganese	41/6	.....
Consol. Murchison	58/1½	+7½d
Mashaba	2d	.....
Natal Navigation	2 1/2	+1/16
Rhod. Monteleo	1/3	.....
Turner & Newall	86/9	—1/3
Wankie	16/6	—4½d
Witbank Colliery	4¼	.....
CANADIAN MINES		
Dome	$30½ XD	.....
Hollinger	$31½	—½
Hudson Bay Mining	$90½	—2½
International Nickel	$89½	—¼
Mining Corpn. of Canada	£6½	.....
Noranda	$139	+½
Quemont	£7½	.....
Yukon	3/9XD	.....
OIL		
Anglo-Iranian	16 3/16	+1/16
Apex	28/6	+1/-
Attock	46/3	.....
Burmah	107/6	+7/-
Canadian Eagle	36/6	—3d
Mexican Eagle	20/10½	+7½d
Shell (bearer)	5 1/2	.....
Trinidad Leasehold	28/9	+1/9
T.P.D.	27/6	.....
Ultramar	27/6	—9d

COMPANY NEWS AND VIEWS

Rand and O.F.S. Returns—September

Monthly returns for September in respect of Rand and O.F.S. producing mines are listed in the table below. They are based upon the higher gold price of 249s. 7d. per oz. during September as against 248s. 4d. in the previous month.

Generally speaking, no points of exceptional interest arise in connection with the older producers and the new properties of the O.F.S. have again provided the most outstanding results. Amongst these is the excellent maiden month's production reported by Harmony—the new Central Mining Property in the southern part of the O.F.S.—which was officially opened last month. From a total of 40,000 tons of ore milled at this mine, 13,007 oz. gold were produced (a mill grade of 6½ dwt.), yielding a working profit of £32,120. This initial mill grade, however encouraging, is, of course, only an indication of that expected for the future for development results at the mine have indicated much higher potential values. In addition, plant capacity will be increased to 90,000 tons monthly in less than a year's time. These factors, combined with the company's statement that profits equal to about one-third of those obtained from gold are expected from uranium production, give some insight into future prospects.

RAND AND O.F.S RETURNS FOR SEPTEMBER, 1954

Company	September 1954 Tons (000)	Yield (oz.)	Profit (£000)	Yr. ends	Current Financial Year Total to date Tons (000)	Yield (oz.)	Profit (£000)	Last Financial Year Total to date Tons (000)	Yield (oz.)	Profit (£000)
Gold Fields										
Doornfontein ..	50	16,672	84·5	J	150	49,673	245·9	—	—	—
Libanon.....	97	20,298	50·9	J	289	60,448	151·6	250	50,770	127·4
Luipaards Vlei .	110	21,748	45·9	J	329	65,006	134·7	319	59,114	126·9
Rietfontein	27	6,145	22·0	D	249	55,883	212·5	240	53,598	227·1
Robinson.....	100	20,930	35·6	D	890	206,254	232·7	881	170,912	118·1
Simmer & Jack.	123	19,974	17·8	D	1130	182,268	109·0	1098	177,740	115·0
Sub Nigel.....	67	21,779	94·6	J	200	65,636	284·1	200	66,567	311·6
Venterspost	106	26,182	63·0	J	320	78,570	184·8	313	73,189	168·5
Vlakfontein	39	14,107	73·7	D	347	124,126	642·0	330	119,968	643·0
Vogels	103	26,471	112·7	D	922	233,874	982·5	873	220,622	886·9
West Drie	52	39,192	302·8	J	155	116,800	907·8	132	92,426	745·2
Anglo American										
Brakpan.....	108	18,333	14·1	D	993	167,435	120·6	1032	184,741	200·1
Daggas.....	228	52,393	327·8	D	1999	463,698	2854·0	1970	464,324	2982·3
East Daggas ...	94	15,912	47·3	D	840	142,594	416·7	819	142,324	436·6
Pres't Brand (A)	31	15,500	80·4	D	61	27,792	134·4	—	—	—
President Steyn	55	17,211	60·8	D	261	73,903	164·1	—	—	—
S.A. Lands	105	19,371	58·7	D	906	166,856	490·4	901	164,122	461·8
Springs.....	127	17,564	7·7	D	1162	162,433	68·2	1324	182,158	94·7
Welkom.....	74	15,650	12·0	D	642	128,590	44·9	561	109,547	110·3
Western Hdgs. .	52	20,557	110·0	D	426	149,468	583·7	109	28,554	30·0
West. Reef Ex..	118	22,647	64·9	D	1040	204,214	584·7	979	200,427	720·4
Central Mining										
Blyvoor	104	59,386	457·8	J	324	184,731	1432·3	306	181,172	1504·1
City Deep	161	30,885	14·3	D	1475	281,218	145·3	1426	276,583	196·2
Cons. M.R.....	175	24,895	26·6	J	550	76,820	91·7	519	71,288	58·6
Crown	296	46,661	53·6	D	2579	407,559	448·0	2429	386,086	361·8
D. Roodepoort	183	29,881	50·6	D	1600	264,445	413·6	1605	270,223	581·7
East Rand Prop.	209	47,647	133·5	D	1826	413,641	1108·7	1701	375,407	985·2
Harmony (B) ..	40	13,007	32·1	J	40	13,007	32·1	—	—	—
Modder B.....	56	5,918	3·0	D	509	53,227	23·6	489	52,229	15·0
Modder East...	119	13,517	14·3	J	357	40,709	38·0	356	40,087	46·5
Rose Deep.....	69	10,469	9·4	D	636	96,555	105·1	658	97,982	74·5
Welgedacht	33	3,775	1·6	J	98	11,590	5·0	103	12,746	10·5
J C.I.*										
E. Champ d'Or.	19	1,839†	5·1†	D	203	19,797	57·5	218	34,417	3·7
Freddies Cons. .	95	14,726	L14·5	D	708	119,038	L168·0	74	25,838	L71·7
Govt. G.M.A...	260	33,751‡	34·0‡	D	2342	304,892	279·5	2203	298,685	480·6
Randfontein ...	274	34,835†	65·1†	D	2585	337,598	268·1	2753	35,208	242·0
Union										
East Geduld ...	144	44,284	329·5	D	1228	377,603	2760·5	1222	366,933	2732·5
Geduld Prop. ..	96	15,616	35·6	D	834	135,855	253·1	855	135,576	288·1
Grootvlei.....	183	39,335	221·4	D	1622	345,995	1931·4	1663	354,445	2084·4
Marievale	69	17,637	86·1	D	590	150,324	668·8	563	137,526	596·7
St. Helena	94	21,616	74·3	D	747	166,270	495·4	576	115,434	197·1
Van Dyk	77	13,101	1·7	D	706	121,611	15·8	788	127,937	5·5
General Mining										
EllatonGd.Mng	28	9,852	60·9	D	239	71,498	350·4	—	—	—
S. Roodepoort .	28	5,927	20·3	J	84	17,988	61·6	84	18,088	61·0
Stilfontein	84	32,140	207·0	D	740	254,873	1494·8	569	165,063	813·9
W. Rand Cons..	227	29,110	197·28	D	2038	256,414	1680·3	2003	279,435	788·6
Anglo-Transvaal										
N. Klerksdorp .	11	1,498	·3	D	101	8,184	L11·0	94	12,756	5·8
Rand Leases	184	31,096	45·1	J	554	93,256	128·1	485	82,697	41·7
Village M R....	35	5,114	10·2	J	105	15,606	32·5	102	15,912	36·0
Others										
N. Kleinfontein	107	13,272	11·5	D	969	120,554	130·3	963	124,441	232·5
Nigel Gold	27	4,156	5·4	D	251	38,720	12·7	283	40,085	L8·6
Spaarwater	11	2,770	1·2	D	96	24,183	3·0	93	21,415	L28·7
W. Nigel	18	3,987	9·7	J	53	11,787	28·5	51	11,588	22·4

Notes.—Profit figures are in all cases figures of working profit excluding profit from sale of gold at premium prices. In cases of groups marked with an asterisk (*) profit includes sundry revenue. Profit figures preceded by L indicate a loss. † Gold and Uranium. ‡Gold and Pyrite. § Including £195,000 from sales of uranium. (A) Production commenced August 1954. (B) Production commenced September 1954.

Despite the rise in costs at President Brand, fluctuations in respect of which are not unusual in the case of a new mine, a swift advance was made from the initial monthly profit figure of £53,997 to £80,390. The milling grade which advanced from the 8 dwt. level reported last month to about 10 dwt. per ton was responsible for this added profitability. At Welkom there was also a rise in grade and in the total ounces produced, although a smaller tonnage of ore was milled. Here also costs rose slightly, but did not prevent a useful gain in working profit being recorded. The mill grade also improved at Western Holdings, and although costs rose slightly, profits increased by about £10,000. Notable for its decreased costs, however, was President Steyn and less mining expenditure, together with a slightly better grade, gave a useful boost to profits.

In the Union Corporation group, St. Helena made further progress with an increase in tonnage, gold produced, and profits; costs also declined from last month's figure. A greater tonnage was milled at Freddies Consolidated, indicating possibly that the company' objective of progressively expanding the milling rate to an economic level may now be getting under way. This increase in output resulted in a sharp fall in costs and a subsequent marked decrease in working losses.

In the Far West Rand, both Stilfontein and Ellaton, which were involved in the recent merger between Strathmore Consolidated and General Mining, both made slightly higher profits. It will be remembered that Ellaton only started production in January this year since when it has made remarkable progress.

Diamond Sales Still Running at Last Year's Level

Despite a slight decline in total diamond sales effected by the Central Selling Organization during the September quarter as compared with the previous three months, cumulative figures in respect of nine months of the current year show that total sales are still running at just over last year's level.

Quarter 1954	*Gems* £	*Industrials* £	*Totals* £
September	11,232,441	3,137,337	14,369,778
June	11,737,546	3,326,371	15,063,917
March	11,773,849	4,881,215	16,655,064
Total for nine months	34,743,836	11,344,923	46,088,759

Quarter 1953	*Gems* £	*Industrials* £	*Totals* £
December	10,733,315	4,835,352	15,568,667
September	9,303,346	4,833,746	14,137,092
June	8,792,258	4,084,716	12,876,974
March	14,507,190	4,066,018	18,573,208
Total for 1953 ...	43,336,109	17,819,832	61,155,941

If this trend continues during the next three months, total sales for the year would be equivalent to over £61,000,000, which would compare almost exactly with the total reached in 1953. It will be recalled that sales during the record year for diamonds, 1952, touched a level of £69,600,000.

Gold Fields to Form Saaiplaas Company

It has been announced by New Consolidated Free State Exploration, a company formed by New Consolidated Gold Fields for the purpose of exploration in the O.F.S., that following an agreement between the interested parties concerning the definition of a mining area, application is to be made to the South African Government for a mining lease to work the Saaiplaas ground in the O.F.S.

This announcement scarcely comes as a surprise, as it has been known for some years that there was at least one mine in the making in the vicinity north of Harmony, while in addition, last year, negotiations for the preparation of terms for a lease were reported to be in progress. Much, however, will be expected from the drilling programme which has given most encouraging results with values up to 1,500 in. dwt.

On the receipt of a mining lease from the government, it is intended to form a company to work the property. The largest participation in this company will go to New Consolidated which will be entitled to about 55 per cent of the vendor consideration, subscription rights, and underwriting together with a refund of about £168,000 in settlement of past drilling expenses. There will, however, be certain sub-participations in

this allotment by other interested parties, which include New Wit Gold and Anglo American Corporation. Of the remaining 45 per cent, Middle Wits, South African H.E. Proprietary and New Free State Gold will be the participants.

As initial work on the property will be concerned with shaft sinking to reef depth of about 6,000 ft., some little time must be expected to elapse before much interesting news is heard. When the shafts are nearing the reefs, however, apart from the interest which will be aroused with regard to possible gold values, there will at that time undoubtedly also be much speculation as to whether the uranium deposits of the Harmony property are to be found also in the new area.

It is unlikely that any public issue of shares in the new company will be made in the near future.

Virginia Applies For Extensions to Uranium Plant

Of particular note in the circular, which sets out details of the impending share issues by Virginia Orange Free State Gold Mining Company of 3,075,000 5s. shares at 10s. a share in the ratio of 3 for 10, is the disclosure that application has been made for authority to extend the capacity of the company's uranium plant and possibly that of the sulphuric acid plant also.

At the present time £3,000,000 of the present £12,000,000 which represent the borrowing powers of the company has been expended on uranium and sulphuric acid production while £8,100,000 has been spent on gold production, leaving a balance of only £900,000 available. A proposal has therefore been put forward to increase the borrowing powers of the company to £14,500,000.

It is estimated that due to the delays which have occurred in bringing the mine to production, another £720,000 may be needed for gold mining expenditure and other contingencies before the funds from the proposed new share issue become available. Furthermore, if application is granted for the increase in capacities of uranium and sulphuric acid plants an additional amount of £680,000 will have to be spent. It is therefore considered that in order to avoid delays which might arise in the event of the uranium plant extension being authorized, arrangements should be made now for the additional borrowing power rather than at a later date.

Buffels To Make Public Issue

It has been announced by the Strathmore Management Company—Secretaries to Strathmore Consolidated Investment—that the long awaited public flotation of Buffelsfontein Gold Mine, situated in the Klerksdorp district of the Transvaal, is now to be made.

The offer is very similar to that made by Hartebeestfontein, its northerly neighbour in February this year, and takes the form of allotments of shares to the interested parties at 16s. per share in the following proportions: New Pioneer, 14 for 25; Middle Wits, 1 for 8; Eastern Rand Extensions, 1 for 4; Alpha Free State Holdings, 9 for 25; and Southern Van Ryn Gold, 2 for 25. The offer is to be made to shareholders registered at the close of business on October 21 next.

As it is stated that "further details" of the offer will be published on October 12, all financial and technical arrangements for the short and long term operation of the mine will presumably be disclosed at that date. In the case of "Harties," which covers an area very similar in size to "Buffels," the objective of the recent share issue was to bring the mine into production at a milling rate of 75,000 tons per month during 1956. It, therefore, remains to be seen whether this rate of monthly production will be aimed at also in the case of "Buffels."

Furthermore, in view of the closer association between General Mining and the Anglo American Corporation which the recent General Mining-Strathmore merger would seem to imply, it would perhaps not be amiss to assume that assistance in the form of loans will be forthcoming from the Corporation, as indeed they were in the case of Hartebeestfontein.

Development Results at Loraine

At an extraordinary meeting of Loraine Gold Mines held in Johannesburg this week to consider special resolutions for increasing the authorized capital of the company from £7,500,000 to £9,625,000 in shares of 10s. each and the issue of 4,500,000 new shares—both of which resolutions were passed by shareholders—details of development at the mine during the September quarter were disclosed.

Of the total footage advanced, which amounted to 24,041 ft., 3,015 ft. were sampled on reef, 75.95 per cent of which was payable and had an average value of 42.93 dwt. gold per ton over 6.26 in. or 269 in. dwt. Last quarter a slightly higher payability was reported at 85.5 per cent together with values of 323 in. dwt. It was also stated that trial milling operations started on October 1.

Cape Asbestos—Cash and Bonus Issues

In addition to a proposal that the authorized ordinary capital of Cape Asbestos should be increased from 5,000,000 shares of 5s. to 12,000,000 shares of the same nominal value, and that 4,018,560 ordinary shares should be issued by way of capitalization of reserves in the ratio of one for one, it is also proposed to approach shareholders for new money with which to finance the group's expansion programme.

An offer will accordingly be made of 2,962,880 new ordinary 5s. shares in the proportion of 11 for every 30 held after the above bonus issue has been concluded. The terms at which this issue will be made have not yet been fixed.

It is also intended to offer the balance of authorized preference capital, which amounts to 82,560 shares of £1, to preference holders at par in the proportion of 49 for every 100 held.

A circular giving full details of the above issues and notice of the necessary meetings is to be issued shortly. Mr. R. Walker is chairman.

Rhokana Proposes Increase in Borrowing Powers

In a circular to shareholders it is proposed by the Rhokana Corporation that the borrowing powers of the company should be increased to three times the issued ordinary capital—or by about £7,500,000.

The reason for this proposal is that the Corporation wishes to borrow from the Rhodesia Congo Power Corporation to meet commitments arising from the joint power scheme undertaken by copper mining companies in Northern Rhodesia. In addition, it is stated that loans may be required for "other purposes." There is, however, no immediate intention of exercising more than a fraction of the borrowing powers sought.

An extraordinary meeting has accordingly been arranged to take place in Northern Rhodesia on October 27 to consider these proposals.

North Broken Hill Raises Dividend by 20 Per Cent

The recommendation of a final dividend of 60 per cent by North Broken Hill, the Australian lead-zinc producer, on its issued ordinary capital of £700,000 in 5s. stock units brings the total distribution for the year ended June 30, 1954, to 110 per cent as against 90 per cent in respect of the preceding period.

Net profits after taxation, depreciation, etc., earned during the year rose to £1,768,087 compared with £1,600,058. Appropriations for new plant and mine development not deducted from these profit figures were £920,000 as against £910,894 previously. Mr. M. H. Baillieu is chairman.

Broken Hill South, Profit Down—Dividend Up

A preliminary profit statement cabled to Austral Development from Broken Hill South, the Australian lead-zinc producer, discloses that the combined net profit of the company and Barrier Central Pty., its subsidiary, for the year ended June 30, 1954, was £1,278,362 after providing for taxation and mining royalty. This figure compares with £1,462,011 in respect of the previous period.

However, a final dividend of 70 per cent has been recommended on the company's issued ordinary capital of £800,000 in 5s. stock units which compares with the previous 60 per cent interim, bringing total distribution for the year to 130 per cent as compared with 120 per cent for the preceding period.

W.M.C. To Make Share Issue

As foreshadowed by the chairman, Mr. G. Lindesay Clark, at the annual general meeting of the Western Mining Corporation, held in Melbourne on September 16, a new issue of 931,450 shares of 5s. each will be offered to shareholders at 12s. 6d. a share on the basis of one new share for three held. This new money is required for the purpose of financing the corporation's expanding interests in gold, together with its participation in prospecting for uranium and oil. Of the issue price 1s. per share will be payable on acceptance by November 22, 1954, and 5s. per share by way of a first call to be

made in February next year. The balance of 6s. 6d. per share is to be called up as and when required.

It is stated that the new shares will not participate in any dividend declared prior to the close of the current financial year ending March 31, 1955, but thereafter will rank for dividend in proportion to the amount of capital paid up. In the absence of any material change from existing conditions, it is expected that dividends at the current yearly rate of 1s. per old share and *pro rata* on the new shares, will be maintained. The issue has been underwritten. W.M.C. 5s. shares now stand at a middle price of about 12s. 3d.

Beralt's Reduced Revenue

Due mainly to the steady decline in the price of wolfram, revenue earned by Beralt Tin and Wolfram during the year ended March 31, 1954, fell considerably. In fact, the price, which at April 1, 1953, was 330s. per unit, had fallen by the end of February, 1954, to 100s. per unit. A slight recovery to 130s. was, however, made by the end of the company's financial year.

As in the case of the previous year the company was to some extent insulated from market falls owing to previously negotiated long-term contracts at prices higher than current market averages. Nevertheless, the extent of this insulation must have been considerably less last year than during the year ended March 31, 1952, when over half of the company's production was covered. For at the end of October, 1953, Mr. F. Gates, the chairman, stated that contract sales of wolfram after the first six months of the then current financial year would cover less than one-quarter of total production.

Output of wolfram during the year showed an increase to 2,271 tons as against 2,127 tons in the preceding period, while that for tin fell to 96 tons as against 144 tons previously.

Year to Mar. 31	*Total Revenue*	*Taxation*	*Net Profit*	*Dividends*	*To Reserve*	*Carry Forward*
	£	£	£	£	£	£
1954	2,680,114	1,433,533	252,240	218,460	nil	254,500
1953	3,553,227	1,999,575	462,818	321,070	99,538	220,720

Note—Expenditure in Portugal £962,090 (1953 - £943,997)

Dividends on the company's issued capital of £331,000 in ordinary stock units of 5s. were accordingly reduced to 120 per cent as against 180 per cent for the previous year.

Although shareholders must wait until October 28 for the chairman, Mr. F. Gates, to give his review of the past year's operations, current production figures for the first six months of the present financial year show that output of wolfram has fallen to 1,014 tons as compared with 1,116 tons in the corresponding previous period. Tin production has suffered a more serious drop to 29 tons as against 47 tons previously.

Beralt Tin's 5s. ordinary shares now stand at about 25s. 6d. at which price they yield over 25 per cent—an extremely high return which, in view of the uncertain level of current wolfram prices, discounts the possibility of future falls. Meeting, London, October 28.

Sons of Gwalia's Capital Expenditure Programme

Despite an increase in the milling rate at Sons of Gwalia to 112,588 tons from which 26,001 oz. of gold were recovered as compared with 95,494 tons milled and 23,768 oz. in the preceding period, operations during the year ended December 31, 1953, due mainly to a sharp increase in costs, resulted in a loss of £6,106 as against the previous profit of £13,908. The company's carry forward was accordingly reduced to £25,030 as against £31,083 previously.

Since the end of the financial year, as a result of heavy monthly losses at the mine—a situation which has since improved—an investigation was carried out by Mr. K. J. Finucane, a well-known Western Australian geologist. The findings of this investigation were later summarized in a report by Bewick Moreing and Co., consulting engineers, from which a programme of re-organization and capital expenditure has emerged.

Developments in depth below the 30 Level are considered sufficiently promising to warrant a continuation of development and mining. It was recommended that with the introduction of various new measures including a programme of underground mechanization and mill modernization, output could be increased to 12,000 tons per four-weekly period. This, together with improved efficiency would reduce costs considerably and if a 5 dwt. grade of ore were milled an annual profit of £96,950 should result. Taking a grade of 5.5 dwt. the profit from a similar tonnage milled would rise to £146,250. It is estimated that to put this plan into effect an amount of £215,900 would be required for capital expenditure purposes.

In order to keep the mine in operation during the investigation the company was successful in obtaining financial assistance from the Government of Western Australia and the National Bank of Australia. Furthermore, having studied the report, the Government are prepared to advance £80,000 for the new programme provided that the company in its turn raises £136,000, a matter which is at present under consideration and details of which will be submitted to shareholders soon.

Production figures in respect of the first nine months of the current financial year show that from a total tonnage milled of 73,700 as against 79,700 previously, a total of 16,758 oz. of gold have been recovered as compared with 17,990 oz. in the preceding period.

Meeting, October 26, London. Capt. A. H. Moreing is chairman.

Tekka Maintains Revenue

Despite the very much lower price received for tin concentrates produced during the year to March 31, 1954, Tekka, the Malayan alluvial tin mining company, managed to maintain its income. This was possible owing to the greatly increased tonnage of ore sold which was the outcome of a larger area of ground treated of a substantially higher grade than that in the preceding period.

Year to Mar. 31	*Treated cu. yd.* (000)	*Per cubic yard Yield* (*lb.*)	*Cost* (*Pence*)	*Output* (*In tons concs.*)	*Ore sales Price Received* £	*tons*
1954	506.0	.67	16.63	149.4	380	149.4
1953	482.4	.51	16.98	109.2	542	109.2

Dividends on the company's issued ordinary capital of £358,577 in shares of £1 were maintained at 5 per cent.

Year to Mar. 31	*Total** *Revenue*	*Taxation*	*Net Profit*†	*Dividends*	*To Reserve*	*Carry Forward*
	£	£	£	£	£	£
1954	82,531	16,142	10,962	9,861	nil	28,321
1953	85,340	19,089	15,060	9,636	5,205	27,220

* Including sales of tin ore £68,351 (1953 - £72,449)
† After £6,000 written off capital expenditure (1953 - £1,183)

Prospects for the current financial year should be brighter due to the recovery in the price of tin since last March. It is not expected that there will be any appreciable change in the overall production for the current year as compared with that covered by the accounts. Production during the first five months of the current financial year amounted to 54¼ tons of tin ore.

Meeting, Redruth, October 22. Mr. Donald W. Thomas is chairman.

Tronoh's Capital Structure and Siamese Venture

At last week's general meeting of Tronoh Mines, the Malayan tin dredging company, it was disclosed by Mr. J. H. Rich, the chairman, that the question of the capital structure of the company has been under consideration. Although he was able at this stage to give no concrete proposals, it is hoped that a scheme to bring the capital of the company more into line with the assets would be proposed in the near future.

Mr. Rich also referred to the Tromal Prospecting Company which has been prospecting for tin-bearing areas off the coast of Siam. Applications by this company for mining leases which had been lodged with the Siamese Government, he stated, had now been granted. They cover a total area of some 7,500 acres with a lease duration which extends over a period of 25 years from January 1, 1954. Tin values in this area are confined to a bed 12-15 ft. thick below 60-70 ft. of sea. It is estimated that some 49,000,000 yards have been been prooved having an average value of 1.45 kali per cu. yd., representing 42,292 tons of tin concentrates.

In view of the rather unique occurrence of the deposit a handling method similar to that used in harbour dredging operations is to be employed. It is estimated that by this method a total of 120,000 cu. yd. a month will be dredged which on the basis of working costs at 80 c. per cu. yd. and a tin metal price of £600 per ton would bring in an annual profit equivalent to 39 per cent on the capital of $6,000,000 providing for amortization over 34 years. If a period of 25 years were taken—the same as the lease duration—this yield would be reduced to 37 per cent.

With this stage in the proceedings being reached it was decided to form a new operating company named Aokam Tin to take over from the purely prospecting company Tromal. The new company is accordingly being incorporated in the Federation of Malaya and of the authorized capital of $7,000,000 (Straits) in shares of $1 each, the initial issue will amount to $6,000,000. Of this amount the Siamese Government will subscribe 45 per cent while the balance will be taken up by companies in the Tronoh Malayan Tin Group in proportion to their holdings in Tromal Prospecting.

Owing to the somewhat extensive technical arrangements which must be completed before production can start, it is not expected that operations will begin before twelve months' time.

Hongkong Tin Soon to Re-Start Production

Since the early part of this year only limited production has been carried out by Hongkong Tin, the Malayan tin dredging company. For at the beginning of March the dredge started to dig its dock in order that a programme of constructional work for its conversion could be undertaken.

It is now announced, however, that the dredge has been refloated in the paddock and is now operating intermittently while undergoing trials. But since the company's financial year ended on September 30, it is unlikely that the year's production will be much above that reached by the end of March when the total of 149¼ tons of tin ore produced compared with 186½ tons in the preceding period. On the other hand, now that modernization will have enabled the dredge to treat the widely varying graduations of tin ore available in selected areas on the company's property, future prospects should be favourable. Output in respect of the March quarter just prior to closure was over 100 tons of tin ore. No dividend has been declared by this company since that of 10 per cent on the issued ordinary capital of £150,000 in 5s. stock units for the year 1950-51.

Naraguta K. and E. Pay Less: Puket Pays Nil

Two preliminary profit statements and dividend recommendations have been received. They are in respect of Naraguta Karama Areas and Naraguta Extended Areas, both of which companies operate hydraulic tin properties in the Bauchi province of Northern Nigeria and ended their financial years on December 31, 1953.

In the case of Naraguta Karama operations during the year resulted in the production of 164½ tons of tin ore as against 133¾ tons previously. Nevertheless, a loss of £8.097 was made which compares with the previous year's profit of £11,459. Consequently, a final dividend only of 7½ per cent has been recommended on the company's issued ordinary capital of £80,000 in 5s. shares as against the previous year's interim and final dividends which together totalled 9 per cent.

Naraguta Extended announced that a loss of £3,560 had been made as against the previous year's profit of £9,152. Output of tin ore dropped from 90 tons previously to 81 tons and in this case also a final dividend only has been recommended and amounted to 5 per cent on the issued capital of £103,655 in shares of 2s. each. This compares with the previous interim and final dividends which together made a total of 7½ per cent.

The full reports and accounts have also been received from Puket Tin Dredging, an alluvial tin mining property on the island of Puket in Thailand. Tin ore recovered by this company during the year to December 31, 1953, fell to 312.4 tons as against 491.8 tons previously. Sales of ore and other revenue brought in £144,988 (£279,785) and after expenses, tax and all charges a loss of £3,387 was made against a profit of £59,468 previously. No dividend was recommended on the issued capital of £250,000 in units of 5s. as against 25 per cent previously. Mr. G. R. Mitchison is chairman. Meeting, London, October 13.

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Obituary

SIR JOHN BAGNALL

The death of Sir John Bagnall, formerly chairman of the Straits Trading Co. Ltd., was briefly reported in our last issue. Below we publish an appreciation of Bagnall's career, which we have received from his colleague Mr. W. J. Wilcoxon.

Mr. Wilcoxon writes: Sir John Bagnall, who died in Johannesburg on September 29, 1954, was born in Liverpool on May 23, 1888. He was educated at the Liverpool Institute and commenced his business career in 1904 in the service of Messrs. Alfred Holt and Co., the Blue Funnel Line, Liverpool. Leaving them he joined the service of the Straits Trading Co. Ltd., tin smelters, Singapore, and arrived in the Colony on July 18, 1912. His capacity for hard work quickly earned him promotion and in 1922 he was appointed chairman and a managing director of the company. He continued in that capacity until he left Singapore on official instructions on February 13, 1942, preceding its capitulation to the Japanese.

The vessel on which he sailed from Singapore was bombed by the Japanese and sunk in the Rhio Straits with much loss of life, but Bagnall, a powerful swimmer, was fortunately saved. After a strenuous and exciting overland journey across Sumatra he and other survivers reached Padang, from which port they subsequently sailed for Colombo. From Colombo he travelled to Durban where he and Lady Bagnall lived for a time. During his stay in Durban he undertook voluntary work for the South African Red Cross Organization in connection with Malayan refugee problems until he came to London in 1945.

He returned to Singapore in 1946 following its re-occupation by the British Forces, and, with those former members of the staff who were available and able to proceed to Singapore, he re-established the company's business there.

In 1947 he retired from the chairmanship of the company which he had served for 35 years, and he and Lady Bagnall settled down in Johannesburg.

Sir John Bagnall rendered, ungrudgingly and efficiently, great service to the Colony of Singapore during his long residence there. He was an elected member of the Legislative Council of the Straits Settlements from 1926 to 1939, and an unofficial member of the Executive Council, Straits Settlements, from 1935 to 1942. He was also chairman of the Singapore Chamber of Commerce from 1927 to 1932. He was forthright in his criticism of the Local Government when in his opinion it appeared to be necessary, but he was a capable and a loyal colleague whose sincerity was never doubted. He was knighted in 1936. He was a man of sterling qualities, had a zest for hard work and fair play and, while at times outspoken, he was a staunch and generous personality whose loss will be sincerely mourned by all those who knew him.

He is survived by his widow, Lady Bagnall, to whom sympathy will be extended.

Mining Men

Anglo American-General Mining-Strathmore Board changes. The various Board changes foreshadowed at the time of the announcement of the General Mining-Strathmore merger and of the exchange of share interests between the Anglo American Corporation and the General Mining and Finance Corporation (see *M.J.* July 30, page 137) have now taken place, with the result that Sir Ernest Oppenheimer has joined the Board of General Mining and Sir George Albu the Board of Anglo American. At the same time, Messrs. Jack Scott, C. W. Roper, K. A. Keith and M. Menzies, former directors of Strathmore, have joined the Board of General Mining. Mr. Jack Scott has also been appointed an additional deputy chairman of the Corporation.

The Central Mining and Investment Corporation announces the retirement of Mr. W. H. A. Lawrence at the end of this year, after more than 35 years with the Group. Mr. Lawrence, who is a director and general manager of the company, will be succeeded in this latter capacity by Mr. W. M. Frames. Mr. Frames, together with Mr. S. D. H. Pollen and Mr. T. Muir Warden have been elected to the board. At the same time Mr. G. W. Flint and Mr. R. St. L. Granville have been appointed managers in London, and Sir Jim Sothern Holland, Bt., assistant manager. Mr. Flint will continue to act as secretary to the Corporation, and Mr. J. E. Dexter has been appointed assistant secretary.

Mr. S. G .T. Knott has been appointed a director of the Anglo-French Exploration Company. He will continue as secretary of the company.

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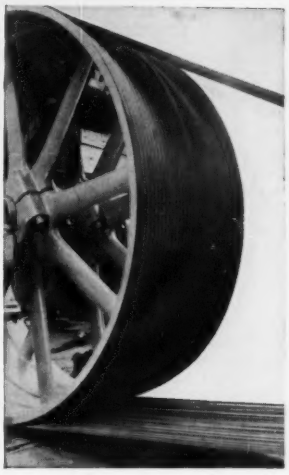

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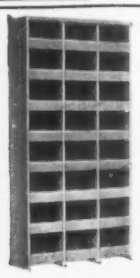

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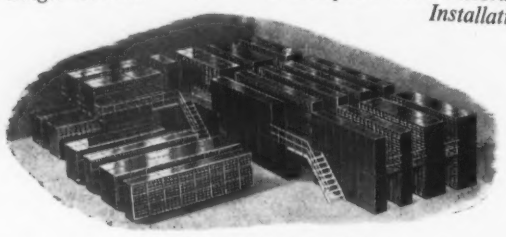

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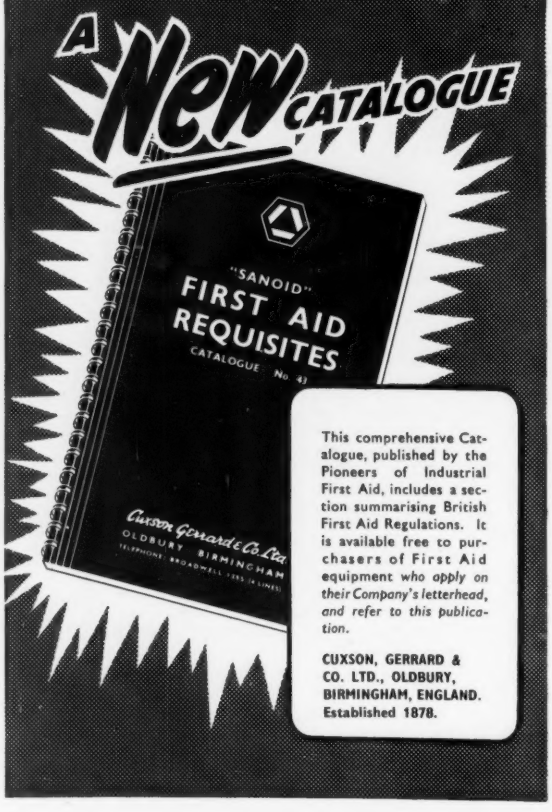
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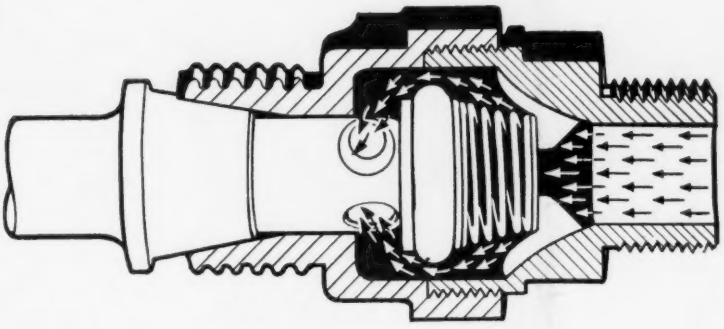
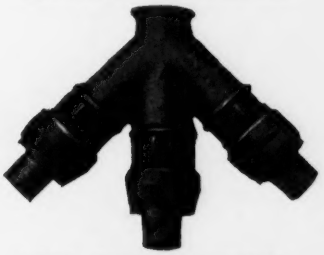


D.P. Automatic Valves are used in all cases where compressed air is supplied to pneumatic tools. Taking the place of air cocks (with all their advantages) they are entirely automatic in action and make leaks and air waste impossible. Besides the advantage of a general air saving with increased tool performance, *the air supply is automatically cut off immediately the tool is disconnected from the hose.* No struggling with refractory air cocks to shut off air supply—no projecting air cocks to suffer damage.
D.P. Automatic Valves are simple, robust and need no attention.

H.P./117—**Single Automatic Valve,** for use between air main and flexible hose or between flexible hose and pneumatic tool.

"D.P." (Cadmium coated) — **Single Automatic Valve,** similar to No. H.P./117, but of lighter construction. Used mainly for fitting between air hose and pneumatic tool.

H.P./116 — **Double Automatic Valve,** for fitting between air main and flexible hose and to operate two pneumatic tools.



H.P./115—**Three-way Automatic Valve,** for fitting between air main and flexible hose, to operate three pneumatic tools.

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